THE HOW-TO MULTIMEDIA MAGAZINE

InterActivity

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Vol. 1, No. 1. Nov./Dec. 1994

InterActivity

72

FEATURES

14 Interactive Fiction
A critical look at the paradigms of the interactive experience such as they are today.

20 Character Animation
We examine the black art of bringing pixels to life in this overview of tools and techniques.

30 Case Study: The Woodstock '94 News
An indepth look at what it took to put together an electronic newspaper twice a day every day amidst masses of people and mud at Woodstock '94.

36 Case Study: Myst
Co-creator Robyn Miller describes every phase of the development process of *Myst*. Discover how a handful of creative people developed one of the most innovative interactive experiences ever using HyperCard as their authoring tool.

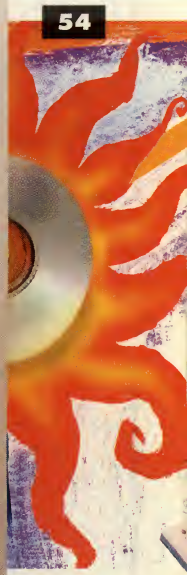
46 Graphic Waveform Editing Demystified
A how-to guide to digital waveform editing techniques.

54 Suite Multimedia
Almost everything you need to know to put together a multimedia production facility, from development platforms to target systems to essential hardware and software tools for creating and integrating text, images, audio, and video.

68 3D Studio Power Tools
Advanced applications and practical how-to tips for Autodesk's powerful 3D modeling software.

72 CD-ROM Production Basics
Learn to burn your own CD-ROMs with this step-by-step guide. Includes listings of formatting software, search and retrieval engines, and CD-recordable drives.

54



HOW-TO COLUMNS

83 Interactive Noise
Sega Music Designer **David Javelosa** describes challenges facing composers working in interactive media and reveals techniques used to create state changing music.

85 Media Babble
Interface design guru **Bill Buxton** pontificates on the importance of social planning along the information superhighway.

90 Authoring Realities
Interactive television designer **William Volk** looks at factors that go into deciding to roll your own or use off-the-shelf authoring tools to assemble multimedia. Includes our own *InterActivity* Guide to Authoring Systems.

99 Frames of Reference
Award-winning QuickTime filmmaker **Chris Meyer** on the tools and techniques of desktop video production.

102 Animata
Animator **Cyrus Lum** on how to avoid the clichés associated with computer generated animation.

102

DEPARTMENTS

3 From the Editor

4 Runtime
Myst goes laser disc. Wavefront opens motion capture centers. Microsoft and Adobe enter the electronic document market. A VR pioneer designs game development tools. SGI branches out. And an independent record label holds an online art revolution.

11 New Gear
The latest in multimedia tools: digital cameras, pressure-sensitive digitizing tablets, a .WAV-to-MIDI file converter, clip media, PowerPC 3D modeling software, an interactive object-oriented programming language, and more.

36

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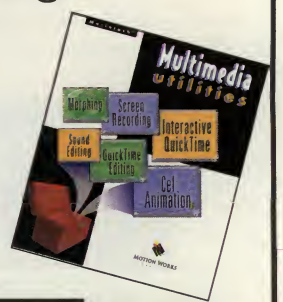

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FROM THE EDITOR

INTERESTING THINGS

Interesting things happen when you announce to the world or portions thereof that you're launching a new magazine. You learn interesting things, go interesting places, meet interesting people . . . and when you call your publication *InterActivity* you get some truly interesting mail.

There's the usual deluge of product announcements, press releases trumpeting budding new and collapsing old partnerships, quarterly profit and loss statements, personnel change notices, "can I write for you?" letters from freelancers, email from long lost friends you never knew you knew . . . and then there's the mail from folks who just didn't get what it was the magazine was about. Prime example: A press release from TRW announcing the completion of the Command Center Processing and Display System-Replacement for NORAD. That is, a Defense Department missile tracking system. Must be interactive, but CCPDS-R doesn't quite fit with the editorial focus we had in mind.

I mean, would the DOD be very cheery if we did a step-by-step case study on the design philosophy and inner workings of their defense network? Would any of you care to read that story? Nah.

So what is it that we are trying to do, and what makes *InterActivity* different from the plethora of multimedia titles already crowding newsstands?

Our goal: To provide developers and enthusiasts with practical hands-on, how-to information about interactive multimedia. Our coverage won't be limited to any one computer platform, so you'll read about Macs, PCs, Unix workstations, and sometimes even super computers. We'll cover all manner of interactive delivery systems from CD-ROM to online, from location-based entertainment systems to whatever else comes along.

We'll present Case Studies (such as those on *Myst, The Woodstock '94 News*, Luscasarts, Toys for Bob, and ARTnet in this issue) that examine the creative and technological development process so you can learn from others' successes and failures. Our How-To Clinics (such as the one on Autodesk's 3D Studio, on page 68) will give you step-by-step tips for today's power tools. Our Instructional Columns, written by some of the top names in their respective fields, cover a wide range of disciplines from digital video to audio, from animation to authoring tools. We'll be adding product reviews and columns covering Business, Imaging, Interface Design, and more in the months to come.

Where other titles talk about the future ramifications of this technology and that partnership, we'll talk about what you can do with the available tools right now. Where some mags get into the cult of technology, we'll pass on being *Rolling Stone* for cyberpunks, and keep our focus on tools, techniques, and the creative challenges faced by everyone trying to work in interactive media.

So who the heck are we? The *InterActivity* crew, like any good multimedia development team, has some pretty varied backgrounds. Her publisherness Pat Cameron and I come from Miller Freeman's music unit (a.k.a. the GPI Group), where Pat is group publisher and I'm editorial director of *Keyboard, Guitar Player, Bass Player*, and other magazines written by musicians for musicians. Managing editor Kathleen Maher is editor of Miller Freeman's computer-aided design magazine, *CADence*. Technical editors Michael Marans and Guy Wright came to us via *Keyboard* and *OS/2* magazines. Marketing director Michael Tchong was the founder of *MacWEEK*, and art director Richard Leeds was recruited from *Guitar Player*. And our research crew was dragged kicking and screaming away from *Keyboard*.

Collectively, we've participated in launching quite a few publications, including *Keyboard, Bass Player, EQ, Drums & Drumming, MacWEEK, Amiga World, Best of Guitar Player, Vintage Gallery, Family Computing, The Austin Chronicle* . . . so you'd think we'd know better than to get caught up in the 16-hours a day, seven days a week, grind of producing a new title yet again. The truth is, we're so caught up in the passion of interactive multimedia, we couldn't help ourselves.

We're brutally proud of this issue. But we're a bit biased. We'd like to know what you think. Drop us a line and add your voice to all that interesting mail we've been getting. *InterActivity*, 411 Borel Ave. #100, San Mateo, CA 94402. On the Net: interactivity@mfi.com.

Enjoy.

—Dominic Milano
Editor

R U N

Rumor Has It

Michel Kripalani and the team at **Presto Studios** are hard at work developing the follow-up to their landmark *Journeyman Project.* Taking advantage

JM2 makes use of QuickTime 2.0 to produce full-motion transistions.

of QuickTime 2.0 technology, JM2 will feature stunning 3D modeling, 30+ minutes of integrated live action video, and full motion transitions. Sanctuary Wood tells us it's scheduled for release in April '95. Stay tuned for a full-blown *InterActivity* Case Study . . . **Los Alamos National Labs** in conjunction with the National Jewish Center in Denver may be on the verge of testing an online service for the medical community. Utilizing Sybase's Gain Momentum authoring system, they hope to make the vast amount of data related to X-rays they have on file available to Pulmonary physicians around the world. The only hitch is their government sponsors are nervous about loaning out computers once dedicated to defense research . . . The **Warner Music Group** has gotten into the CD-ROM distribution, manufacturing, and packaging business, handling three titles from Hyperbole Studios: *The Madness of Roland, Quantum Gate,* and *The Vortex: Quantum Gate II* . . . Meanwhile, **R.E.M.** and **Madonna** will begin previewing clips from upcoming albums on America Online and CompuServe. Warner Bros. reports R.E.M. will also post a multimedia press kit online . . . After being the first record label to release a recording by a major act — Aerosmith — exclusively online, **Geffen Records** is beta testing *Vid Grid,* a Windows-based rock video moving puzzle game on CD-ROM . . . The cast of ***Star Trek the Next Generation*** spent September in recording sessions at Pacific Coast

Continued on page 6

Just What the World Needs — More Formats

Don't jump! *MYST* will soon be available for your Laser disc player.

Myst on Laser Disc

The speculation is that there are dedicated couch potatoes who are not going to leave their television sets for their computers even to play a game. Banking on that potential market, Pioneer Electronics (USA) is launching its first laser disc in the LaserActive multimedia format. The title is *Myst.* Timed for the Christmas season, the title will be released in early December and is priced at $80 — the median price range for LaserActive titles. That's a bit more than the CD-ROM version costs, but the format promises larger, hi-res visuals and sound. For its next title, Pioneer is working with Illumina Productions of Oakland, California to create *Legacy,* an eco-sensitive title that takes the player into the wilds for a little white-water rafting, mountain climbing, and general survival challenges. The fact that Robert Redford is the co-producer, and will provide some narration, on this product is as much a function of his commitment to ecological issues as an indication of the future collaboration of Hollywood and the San Francisco Bay Area-based multimedia industry. *Legacy* is targeted for a February release.

T I M E

See Me, Hear Me
Intel and AT&T Define Standards

So far, most of the strides in video conferencing seem to have been made on the UNIX platforms. However, even in those companies using SGI's Indy and HP's RISC machines, few businesses are taking advantage of the computers' capabilities for interactive communication. Instead, those machines are dedicated to highend applications such as graphics, CAD, or analysis, while basic e-mail communications through limited network resources are handled by Macs and PCs. What we have here, as Paul Newman once said, is a failure to communicate. Obviously, until the technology becomes as ubiquitous on the desktop as the telephone, this type of interactive computing will not become a reality and that's where AT&T and Intel come into play. The two companies have announced an agreement to develop conferencing standards that will ensure interoperability. Most important: The core of the Intel and AT&T agreement is that the connections can be made across different standards. According to a joint statement from the two companies, "Interoperability will be as easy as making a phone call."

At issue are standards already under development, such as PCS, H.320 and T.120. The Personal Conferencing Specification (PCS) defines an interconnected set of data types, protocols, and interfaces for conferencing and communications in the PC environment. Conforming to this standard will allow products and services to interoperate across such disparate network systems as LAN, ISDN, and analog phone lines. The H.320 standard is an international standard for audio and video conferencing for switched, digital telecom networks such as ISDN. T.120 is a standard in an earlier stage of development. It's expected to be finalized in early 1995 and will define specifications for multipoint communications and application level specifications for data collaboration.

The nuts and bolts of the agreement go something like this: Intel is supporting H.320 in its product ProShare. AT&T through its WorldWorx Network Services will offer connections between PCS and H.320 and both companies swear they will work to ensure the future interoperability of standards. The agreement between Intel and AT&T, two giants looking out for their own interests, makes the promise of true interactivity between computers more attainable. With any luck, the union will develop its own momentum and bring other key players into the game.

Motion Capture Centers

From the hardware standpoint at least, the technology for motion capture is readily accessible and relatively economical. However, the whole point of motion capture is to create realistic, riveting, and exciting live action segments, and the best way to do that is to hire professionals. Wavefront has approached this need in the marketplace by licensing five Performance Animation Centers as sites that Wavefront would be willing to recommend to their customers for motion capture services. It should be pointed out that these companies are not exclusively Wavefront houses, and as is the case in most studios working in the computer generated effects business, they use a variety of software. Giuditta Torino of Mr. Film says they use software from SoftImage and Alias in addition to Wavefront systems. If shopping for a motion capture studio, these five sites are good places to start: Acclaim Entertainment (Oyster Bay, NY) 516.624.8888; Lamb & Company (Minneapolis, MN) 612.333.8666; Mr. Film (Santa Monica, CA) 310.396.0146; Optimum Human Performance Center (Menlo Park, CA) 800.866.3463; and Medilab (Paris, France) 33.1.44.30.44.30.

Mr. Film's Wavefront motion capture played a major role in the creation of the Human Torch for the upcoming *Fantastic Four* movie.

RUN TIME

Rumor Has It

Sound Works in West Hollywood. The project: **Spectrum Holobyte**'s forthcoming series of *Star Trek* CD-ROM games. **Michael Dorn**, **Marina Sirtis**, **Brent Spiner**, **Jonathan Frakes**, and **Gates McFadden** have all journeyed the labyrinth of interactive scripts, which are being digitally recorded and edited on Sonic Solutions workstations . . . **Dave Quesnelle**, whose work appeared in **Don Bluth**'s *Land Before Time* and *All Dogs Go to Heaven*, produced and directed **ReadySoft**'s *BrainDead 13*, a game being released for a myriad of platforms (Mac, PC, Sega, Jaguar CD-ROM) at the new year. Quesnelle and a team of 16 animators and sound designers have been working night and day since April '94 to design and execute the game in record time. *Space Ace*, ReadySoft's sequel to Don Bluth's *Dragon's Lair*, should be out by October . . . **Steven Spielberg** and **ILM** are working on *Casper the Friendly Ghost*. Look for lots of stunning special effects — can the game version be far behind? . . . **Sega** and **Duck Corporation** announced that future Sega platforms, including their Genesis 32X (being launching in November) will include Duck's TrueMotion "S" compression and their Comprending interactive media engine. The TrueMotion "S" technology will enable developers to pack more advanced computer interactivity and full-motion "real" video capabilities into the Sega hardware . . . At the same time, **Crystal Dynamics** licensed the TrueMotion "S" video compression, and used it on two 3DO titles, *The Horde* and *Star Control*, which packed 34 minutes of high-quality video into the 3DO platform and allowed it to be played back without a decompression board . . . **Compton's New Media** is launching a self-help line of CD-ROM titles for PC and Mac. The first title, *Focus for Success*, is based on Robert Nideffer's *Attention Control Training System*. The perfect product for a society with the attention span of a cocker spaniel . . . Not your ordinary lounge chair, the **Flogiston chair** has been ubiquitous at VR shows. Designed to provide unobtrusive support for VR explorers, the chair made

Continued on page 8

The Real News is Online

If there were any doubts that this is the year online publishing takes off, the entry of giants Microsoft and Adobe into the field should put them to rest. Both companies have introduced products that make the creation of online documents much easier and, more importantly, make accessing information more user-friendly and universal.

With the introduction of Acrobat 2.0, Adobe's PostScript-based document exchange technology, the company shows signs of recovering from a dangerous case of hubris. In the first release, Acrobat scored with a product that allowed documents complete with graphics and formatting to be exchanged across multiple platforms and, through Acrobat Distiller, to be compressed to manageable sizes. But they made a mistake when they decided to charge for the reader itself. Anyone wanting to transfer documents had to hope their intended recipients were willing to shell out for the reader. Common sense would dictate that the success of Acrobat would be dependent on the ubiquitous presence of the reader on every computer in the world. This time, in response to a fairly mediocre showing for Acrobat, Adobe is putting the reader out there free for the taking.

To be fair, the online boom, especially the availability of online graphic interfaces for the Internet such as Mosaic and Cello, has radically changed the playing field. Now, Adobe is adapting Acrobat to conform to the demands of this new medium. The new version has more sophisticated search and retrieval functions, including a plug-in that recognizes URL (Universal Resource Locator) links on Internet's World Wide Web, which makes it possible to make hypertext jumps between documents in addition to simply making jumps throughout one document. Adobe has also signed an agreement with the National Center for Super Computing (NTSC) Applications to integrate Adobe's Acrobat document-delivery technology with Mosaic clients of the Internet. Among Acrobat 2.0's new features is password locking for documents, allowing distributors to make some information free and perhaps charge for an authorization code to access more information.

The Acrobat line of products includes a basic document creation tool (Acrobat, $195), and more the advanced Acrobat Pro ($595) and Acrobat for Workgroups ($1,595). The Acrobat Reader is available for Windows, Mac, Unix, and DOS.

The impact of the online revolution has not been lost on Microsoft either, but they've opted for the more universal SGML (Standardized Generalized Markup Language), which uses descriptive tags for textual and graphical elements. A subset of SGML is the required document format for the Internet.

Microsoft's new product, SGML Author works with MicroSoft Word 6.X to export and import documents in the SGML format. Author uses the familiar Word frontend to make the addition of SGML tags easy for users already comfortable with Word. Once created, SGML documents are then readable, with formatting, online with Mosaic.

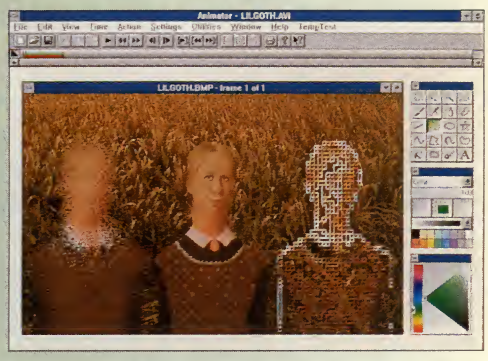
Autodesk Taking on Multimedia

Autodesk figures that as more and more developers are using its software Animator Pro and 3D Studio to develop multimedia titles they might be interested in using an Autodesk product to bring it all together as well. To that end Autodesk announced that it has acquired Mediashare's multimedia authoring technology. Like Autodesk's other products, the Mediashare technology is extensible. A Windows product, Mediashare is object-oriented and, according to Autodesk, developers will be able to put together multimedia components for a variety of applications including kiosks, games and training.

At this year's Siggraph, 3D Studio 4.0 was announced and should be shipping by the time your read this. Called the IPAS version, after the programming interface that allows developers to create add-in products, 4.0 includes several capabilities developed through IPAS, among them are tools for inverse kinematics (a feature allowing 3D Studio to compete with programs designed for character animation), spline-based modeling for more organic forms, fast preview rendering, keyframe scripting, the ability to blend 3D models and photographs through perspective matching, and EPS support for hard copy output.

Also under development in Autodesk's Multimedia Division, and introduced this fall at the Seybold conference in San Francisco, is the latest version of Animator Pro, called Animator Studio. The key features: 24-bit color (Animator Pro was 8-bit), Windows compatibility, an improved interface to replace Animator Pro's enigmatic DOS interface, and (the big blockbuster) audio.

Though Autodesk probably wouldn't agree, it certainly seems that the Animator Pro product was neglected for years while Autodesk put its hopes for a Next Big Thing in the 3D Studio basket. As 3D Studio picked up steam, it seemed 3D animation was the future and Animator Pro was treated as an amusing, but unsophisticated cousin from the country. In spite of the neglect, sales of Animator Pro have been steady. In practice game developers use both 3D and 2D technologies. Cel animation techniques have been transferred from paper to computer and not completely abandoned for the 3D modeling that makes heavy demands on the computer's as well as the animator's time. Given a few years of experience, artists are realizing that not every image on the computer needs to be 3D, nor should every artist expect to mutate painlessly into a 3D modeler.



Autodesk Animator Studio

The addition of audio to Animator promises to extend the usefulness of Animator Studio beyond animation. Its basic sound editing capabilities when combined with animation will make it a powerful preliminary tool for putting together rough cuts if not finished products. At its debut showing at a dealer conference on Autodesk's home turf in San Rafael, the new product got a standing ovation. Its introduction in San Francisco at the Mondo Media offices, a month later, was somewhat more subdued given a tougher audience of multimedia developers and press, but the buzz was there. Autodesk plans to ship Animator Studio in December for $795. (The press conference was held at Mondo Media, by the way, because their game development arm, Mechadeus is using 3D Studio to create their latest title, *The Daedalus Encounter* starring Tia Carrera. Mechadeus' last project was *Critical Path.*)

The extensibility of 3D Studio through its programming tool IPAS has attracted a number of ISVs including Schreiber Inc. of Denver and Xaos of San Francisco. Continuing the trend HSC, developers of Kai's Power Tools have committed to developing add-on tools for 3D Studio. They're also bundling HSC's Gradient Designer 2.0 with Animator Studio.

It's a Virtual World

VR Pioneer Eric Gullichson has resurfaced with a new venture called Warp California. The company's first product is a game development tool called Virtual TV (VTV). VTV allows the display of 3D computer graphics and realworld video at a speed that allows gamers to explore worlds interactively. According to the company, scenes shot with a standard video camera equipped with a fisheye lens can be used directly in a 3D game. At the heart of the product is software video compression technology that makes using video footage practical. VTV is PC-based and works with standard VGA cards. A Pentium equipped with PCI SuperVGA can deliver frame rates of 70 fps.

Gullichson was one of Autodesk's early VR programmers. He went on to form Sense 8, which creates libraries for the creation of Virtual Worlds. Sense 8 has the distinction of being one of the first companies on the market with a VR product, and its libraries have been used by a number of VR developers. Gullichson-eventually left that company and joined with partner Sue Wyshynski, founder of the Vivid Group, to form Warp California. The Vivid Group pioneered technology that allowed the combination of video elements and 3D environments. For instance, a video version of a player could be inserted into an environment as a character. Warp California has picked up a powerful ally in Intel, which is making VTV demo disks available through Intel Multimedia marketing in Santa Clara, California.

RUN TIME

Rumor Has It

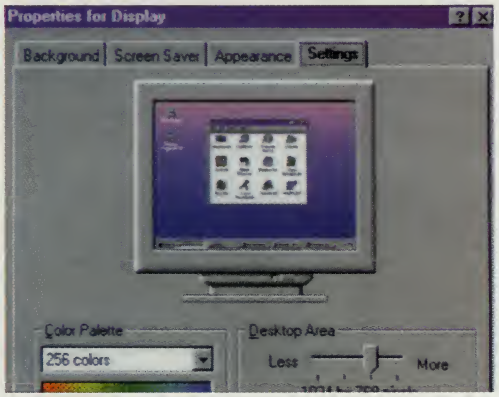
a cameo appearance in *The Lawnmower Man*. The chair's designers have developed the Personal Motion Platform, which has great potential for location-based entertainment, but as it turns out, their first customer is a different kind of explorer — **NASA**. The chair will be used in the Space Administration's Virtual Environment Training System, which uses a head-mounted display and the chair to simulate space travel . . . In the grab for more cable systems, **Time Warner** has joined with two Newhouse-owned companies, **Advance Publications** and **Newhouse Broadcasting Corp.**, in a joint venture that will consolidate some of those cable companies (no one is putting all their cable holdings in the pot). Time Warner is also buying three cable systems from Summit Communications Group of North Carolina. All said, this puts Time Warner up there as one of the largest cable providers in the country. . . VR developers **Division** and **Hewlett-Packard** have formed a strategic alliance to develop virtual reality products. Division will provide their dVS distributed runtime environment, dVISE virtual world authoring software, and ProVision 10 VR accelerator hardware; HP will throw in the HP 9000 Series 700 workstations. They'll sell the VR systems with Division concentrating on the markets they've already opened for their VR products, and HP will go to their clients in the CAD, medicine, training, and simulation fields. . . **Catapult Entertainment** is introducing X-band, a modem system for players of Super Nintendo and Genesis games. Catapult's bulletin board setup is designed to help players find each other and will concentrate on regional sales to develop clusters of players in the same area and reduce long distance charges. Also coming up is **AT&T**'s Edge 16, which allows online play and conversation, but requires specially written cartridges.

Got News? Send it to *InterActivity*, 411 Borel Ave. #100, San Mateo, CA 94402, or fax (415) 358.9527. Internet: interactivity@mfi.com.

SGI Branches Out

Any developer will tell you Silicon Graphics has *the* hardware. When it comes to software, however, there are many more authoring resources for Windows and Mac platforms. In recognition of their need for media integration tools, SGI has established a separate company, Silicon Studio, to "drive development of new interactive applications." Based in Mountain View, California, the new company will be headed by Mike Ramsey, formerly senior vice president of SGI's Visual Systems Group. Among Silicon Studio's first priorities is creating media authoring tools for digital publishing, interactive television, and location based entertainment.

This Year's System



Chicago, Microsoft's much anticipated 32-bit operating system, has been re-christened Windows95. Don't confuse it with NT, Microsoft's 32-bit desktop operating system hyped as everyone's next operating system, but which they quickly repositioned as a server based OS on its release). Chicago95 is scheduled for release in the first half of 1995.

According to Microsoft, customers were confused by their numbering system. Chicago, that is Windows95, could have been called Windows 4.0, since it will replace Windows 3.1. MS felt people would have no trouble identifying the most recent version of Windows if they tagged it with the year of its relase. Given the troubles Microsoft had getting this version out the door (it's more than a year late), this naming strategy seems a bit fraught with peril.

In any case, the new product is designed to replace Windows 3.1, Windows for Workgroups (with TCP/IP support and peer-to-peer networking), and the MS-DOS operating system. Other announced features of Windows 95 are support for long file names, a revised user interface design, and advanced multitasking functions.

For their part, Apple is unafraid of their users' ability to count and has announced that System 7.5 will be shipping this as we go to press. Included in System 7.5 are such features as QuickTime 2.0, AppleScript, MacTCP, PowerTalk, QuickDraw GX, and Apple Guide, as well as long-awaited features such as a Shutdown (a CPU energy saver), colored "Stickies," PC Exchange, Window Shade for minimizing applications, and increased type handling abilities. Apple opted out of the enigmatic name "System." Instead look for (groan) the "Happy Mac" icon to identify the system as the Mac OS.

Online By Design

Artists for Revolution through Technology on the Internet

In these times of retro everything, the idea of something new seems like a virtual unreality. From pseudo pointillism to retro rock, art seems to be going up its own proverbial arse, while technology seems to be chugging ahead with an ever greater head of steam. Art from its inception has always been reliant on a medium by which to express it, and later, distribute it beyond the reach of those with access to the original work itself. This role of distribution seems to always be played by technology, relegating it to second fiddle to the more sensory stimulating, ever-precious world of art. The Internet offers new frontiers for art. Not only does the net provide its own built-in world distribution system, it opens up the possibilities for art yet unseen.

To some artists, the Internet invokes spooky visions of an automated society run by big brother, where the only escape is to some distant realm of cyberspace inhabited by humanoids. To technocrats it's a better place to surf than the Hawaiian Pipeline. But to a group of young artists and compu-techs from Silicon Valley, the heart of the technology beast, this online phenom was just the ticket they'd been looking for.

Artists for Revolution through Technology on the Internet (ARTnet) grew out of a small indie record label's frustration with the ever stagnant, never changing world of music and its corporate bureaucracies. Having chosen to go on the Internet as a promotional device to sell their CDs, members of Quagmire decided to form ARTnet and go one step further. On July 20, 1994, ARTnet debuted the first full-length music album ever on the Internet. The album, A Western Front's *Full Blown Dave*, included all artwork, lyrics, credits, and technical infobits. The road to this event had recently been paved by new technologies that were about to change the world.

Mosaic, compression, and the Internet itself presented ARTnet with possibilities. They could release music, pictures, and words to the world without being forced to deal with a distribution machine bastardized by commercialism. However, there was a stumbling block; the sound quality available for compressed audio was as crude as a Screaming Jay Hawkins 45. MPEG compression was the answer. Formulated to take extremely large files used for laser disc technology and crunch them down to CD-friendly size without losing image or sound quality, MPEG allowed hi-fidelity stereo sound to be put up on the net.

To get on-line, ARTnet needed their own chunk of cyberspace. There were several methods in which to accomplish this. They could get their own Internet server with all the connections, equipment, and expenses. A direct connection could cost over $2,000 per month, not including setup fees (ouch). Equipment can run as little as $1,000 for a 486 running some free UNIX software, such as Linux, or as much as $20,000 for a speedy workstation without the software and utilities needed. ARTnet took a more practical route. They found someone who had all of the gear and connections who was willing to work with them until they were financially able to set up their own server.

The next step was to obtain equipment for encoding the music, artwork, and text. This of course meant having these pieces in digital form (aka on DAT), the artwork scanned, and the text transferred to the computer (typed). ARTnet sought the services of IUMA (Internet Underground Music Archive), who had established their own site on the net and more importantly — had an MPEG encoder. Also, the folks at IUMA were experts at HTML (HyperText Markup Language). HTML is a relatively simple language to use, but IUMA had done some really innovative work with it.

To download and pump your room with those *Full Blown Dave* sounds requires a computer with a stereo soundcard and one of the PC-based MPEG audio players (Mac MPEG is coming) available for downloading at various sites on the Net. A set of powered speakers doesn't hurt either.

ARTnet personnel Dave Beach, Tim Alexander, and Chris Caluzzi wax philosophical about their endeavor: "The possibilities for new forms of art are literally in the hands of the artists and techs with the imagination and knowledge to create them. There are, of course, still some bugs to overcome, not the least of which is the government rearing its ugly mug looking like Big Brother. But if we persevere and keep control, the Internet could be a wellspring of art and information for groups like ARTnet and end users." Amen.

Check out A Western Front's *Full Blown Dave* album at the Quag-Site: http://www.iuma.com/quagmire/ or contact ARTnet at: info@quagmire-gls.com . — Nefol

WWW FOR THOSE IN THE DON'T KNOW

The World Wide Web was developed by a group of physicists at CERN, the European Particle Physics Laboratory. The strength of the Web lies in its ability to link documents to other documents, pictures, files, sound bites, or in this case full stereo songs via hypertext. In 1993, NCSA (National Center for Supercomputing Applications at the University of Illinois) released Mosaic, a frontend browser for the Web. Mosaic allows users to navigate through the Web, browsing pictures (GIFs) and text by a simple click of the mouse. Mosaic allows you to use book marks to save your place on a page while exploring elsewhere. To use Mosaic you need a SLIP (Serial Line Internet Protocol) or a PPP (Point-to-Point Protocol) connection to your provider. If you have a Mac you'll need software such as InterSLIP to connect. If you have a PC you can get software such as Trumpet. All of them can be downloaded at no charge from the net. This software does the communication with your host. Mosaic displays the results.

ILLUSTRATION: JOHN UELAND

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NEW GEAR

MicroNet Master CD and EZ Edit

Burning your own CD-ROMs is becoming more economical, but there are still very real technological roadblocks, not the least of which is the computer's hard disk. MicroNet promises a solution with Master CD, a recording drive designed for writable CD-ROMS. Making use of a Windows interface, Master CD features a system called EZ Edit, which allows you to edit the CD image without creating a separate partition, a 1.2MB cache provides high data transfer rates (up to 8.5MB per minute), and fast access. The Master CD supports ISO 9660, Hi-Sierra, Apple HFS, CD-DA (audio), CD-XA, PhotoCD, CD-I, and Orange Book (multisession) applications. MicroNet reports the Master CD's architecture allows the use of any hard disk as a source; it doesn't have to be a dedicated hard drive. Available with a ISA, EISA, Micro Channel, VESA or PCI local bus adapter, the Master CD is $2,495. Media is available from MicroNet for $25. A Macintosh version is expected to ship before the end of the year. MicroNet Technology, 80 Technology, Irvine, CA 92178. 714.453.6100, 714.453.6101 (fax).

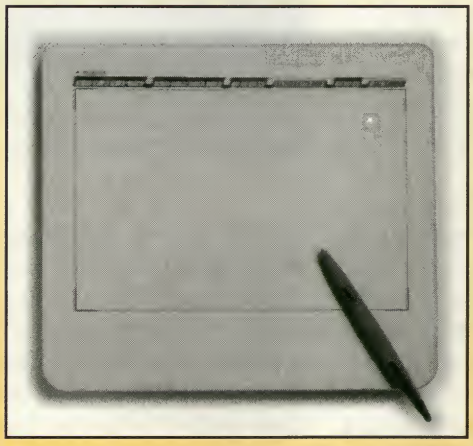
Kodak DCS 460 Digital Camera

The DCS 460 from Eastman Kodak is a portable digital camera based on the Nikon N90 film camera. Capable of capturing 12-bit color images at 3060x2036 resolution, the unit uses a PCMCIA Type 3 card for data storage. It has an option for sound annotation allowing users to identify shots and make audio notes with a microphone. Due to ship in the fourth quarter, the DCS 460 is $27,995. Eastman Kodak, 343 State St., Rochester, NY 14650-0405; 716.724.7007, 309.688.5873 (fax).

DiAcoustics MIDI Renderer

MIDI Renderer is a software-based synthesizer that converts standard MIDI files to .WAV files. It is fully compatible with General MIDI, including its own 128 GM instruments, and features default parameters for its rendering capabilities. Those defaults can be overridden if desired. Each .WAV conversion can create up to 128-voice polyphony. The system also sports 48kHz, 44.1kHz, and 11kHz sample rates, stereo or mono digital audio in 8- or 16-bits, multiple synthesis techniques (additive, FM, sampling, resynthesis, Wave sequencing, physical modeling), and alternate tunings. Compatible with Windows, DOS, and OS/2, it requires 5MB of hard disk space, 2MB of RAM, CD-ROM drive, and a 386 SX processor or higher. Price is $69.95. DiA-

PRESSURE-SENSITIVE TOOLS



Hitachi MultiPad

Hitachi MultiPad

Not one to miss an opportunity, Hitachi introduces a pressure-sensitive digitizer in a 6x9 size that includes a cordless pressure-sensitive pen. The Hitachi digitizer costs $249 ($269 for the Mac version) and offers 2540 lines per inch (lpi) resolution, 256 pressure levels, and 128 tilt levels from -60 to +60 degrees. The digitizer ships in versions for Windows, Macintosh, Silicon Graphics (IRIX OS), Sun MircoSystems Solaris, and Hewlett Packard's HP-UX platforms. Hitachi, 250 E. Caribbean Drive, Sunnyvale, CA 94089. 408.747.2323.

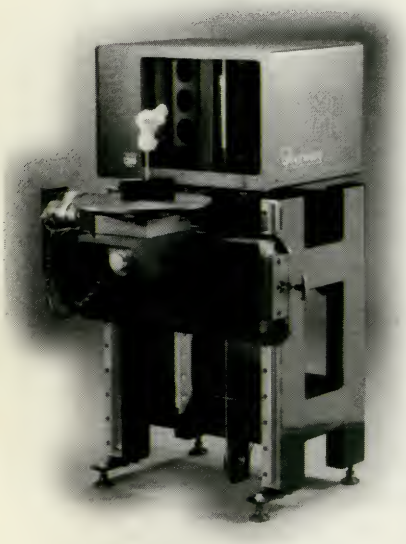
Wacom ArtPad

The latest digitizer from Wacom, pioneers of pressure-sensitive digitizers, is a little 4x5 model for $199. Christened the ArtPad, the digitizer ships with Wacom's UltraPen, which allows pressure-sensitive input. It's also available bundled with Fractal Design Dabbler for $239. Wacom has concentrated on driver software to distinguish its product, which includes pressure customizing controls (256 levels of pressure sensitivity), tablet-to-screen scaling, and pop-up screen macro support. The ArtPad has a resolution of 2540 lpi. Among the other products supporting or planning to support Wacom's pressure sensitivity are Aldus Freehand, Adobe Illustrator, Animation Stand, and Color It! on the Mac, and Animator Pro, Fauve Matisse, Corel Draw!, Picture Publisher, and Hi-Res QFX on the PC. Wacom Technology, 501 S.E. Columbia Shores Blvd., #300, Vancouver, WA 98661. 206.750.8882.

The Personal Digitizer

With the introduction of the Personal Digitizer from Immersion, the price of 3D digitizing has come down. Selling for $1,595 (including software and hardware), the Personal Digitizer allows you to recreate physical 3D objects in the computer by selecting points on the model with a stylus. Objects can be digitized as 3D points, lines, polygon meshes, or splines. The digitizing arm with a full six degrees of freedom is removable allowing awkwardly sized objects to be digitized. The models can be saved in standard file formats and imported into 3D graphics programs such as 3D Studio, Wavefront products, AutoCAD, CadKey, Super 3D, Symbolics, SoftImage, Alias, and Swivel 3D among others. The Personal Digitizer is available for the Macintosh, Amiga and SGI. Immersion, Box 8669; Palo Alto, CA 94309. 415.960.6882, 415.960.6977 (fax).

coustics, 555 Sparkman Dr., Suite 600-F, Huntsville, AL 35816. 205.722.0490.



Cyberware

On the highend, Cyberware color digitizers allow animators and modelers to digitizer complex 3D objects such as human faces. Cyberware products use laser- and video-based technology that quickly scans an object without touching it. Three new Cyberware products have been introduced. CyZip allows models to be built from multiple scans (which is necessary in the case of complicated objects that must be scanned cylindrically and linearly). CySurf creates B-spline surfaces, which use NURBS (non uniform rational b-splines) in contrast to polygon meshes, contain less control points and allow surfaces, and are more compact and realistic looking. Finally, Cyberware introduced the MM Compact Motion Platform for small, complex 3D objects. Its 3030 scanner uses low-intensity laser light to create a lighted profile of an object. It can capture the shape and color of an object in 17 seconds. When displayed on a graphics workstation the 3LD image can then be measured, resized, combined with other models, and edited. Cyberware, 8 Harris Court, Monterey, CA 93940. 408.373.1441, 408.373.3582 (fax).

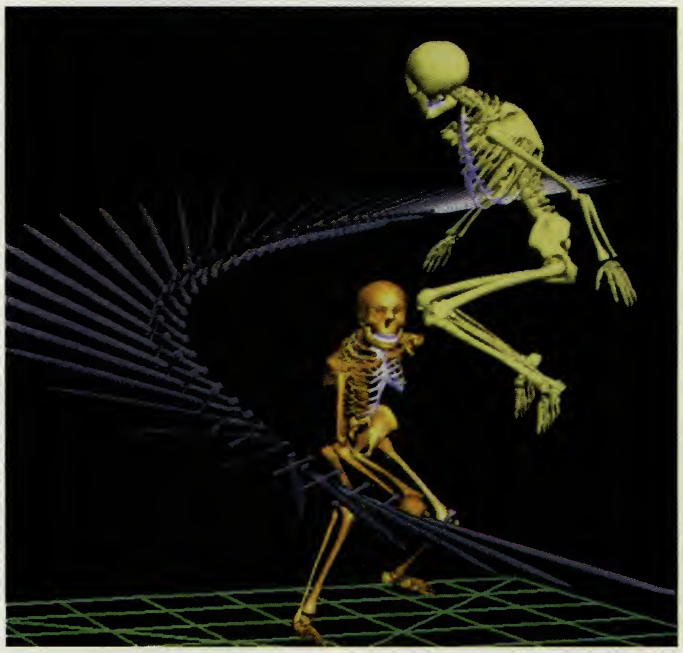
Ray Dream Designer for the Power PC

Taking advantage of the added power so crucial to 3D work, Ray Dream has announced a PowerMac version of Ray Dream Designer. However, to insure maximum compatibility, the product will ship with both the PowerPC and 680x0 version in the same box, allowing you to run the program on either a PowerMac or 680x0-based system. Alternately you can choose Smart Install for the specific machine you are using. As operating systems mutate, this is a strategy we're seeing being adopted by more and more developers, allowing software to migrate to new operating systems with much less trauma.

Ray Dream itself is a 3D modeling product that includes 3D Paint to brush color or texture directly onto an object's surface while automatically calculating lighting and reflections. Modeling Wizard is a library of simple shapes and clip art to enable fast 3D sketching and conceptualization. The Bezier-based Modeler uses bezier curves to create more complex shapes. The product also incorporates a built-in distributed processing technology called DreamNet, which allows rendering to be spread out in a network. The product sells for $349. Designer 3.0 users can upgrade to the Power Macintosh version for $29. Ray Dream, 1804 N. Shoreline Blvd., Mountain View, CA 94043. 415.960.0768, 415.960.1198 (fax).

SGI Multimedia Servers

SGI introduced two new servers targeted at the multimedia market. Part of SGI's Challenge line, the entry level Challenge S server starts at $12,250 and features two Ethernet channels, two fast and wide differential 20 MB/sec SCSI channels, a fast and narrow SCSI channel, and two SGI GIO bus slots, which support additional SCSI, FDDI, ATM, and video options. The Challenge S (starting at $16,600) ships in two configurations: a 100MHz mips R4600 CPU with 500MB disk and 3MB RAM, and a 150MHz R 4400 TM CPU with 1GB system drive and 32MB of RAM. Next up is the Challenge DM server, which starts at $44,800, and is an SMPs server scalable up to four R 4400 100MHz CPUs. It includes 64MB of memory and a 2GB disk. The Challenge DM is designed for heavy duty applications in the database, digital media, file server, and realtime markets. Both servers are designed to leverage the power of the popular Indy desktop system. Silicon Graphics, 2011 N. Shoreline Blvd., Mountain View, CA 94043-1389. 415.960.1980.



BioVision's MotionSets are 3D motion capture files recorded with live actors and stored in ASCII format and are exportable to Alias, SoftImage, Wavefront, and Autodesk animation software.

Images for Sale

Viewpoint Datalabs announced a series of 3D products and the third edition of the standard Dataset catalog. In their most convenient configuration, Viewpoint distributes their data sets on CD-ROM free of charge to developers who then pay a use fee to access and reuse their models. Viewpoint's models are notable for their wealth of detail and, in the case of many of the models, for their accuracy. Viewpoint has also formed a new partnership with BioVision, and are distributing MotionSets, 3D data motion files captured from actual characters. BioVision used a studio and professional actors to create these motion capture data files in ASCII format, which can be imported into animation products from Alias, SoftImage, Wavefront (Preview and Kinemation), and the Shreiber Magic Puppeteer add-on to 3D Studio. Viewpoint Datalabs, 870 West Center, Orem, UT 84057. 801.224.2222, 801.224.2272 (fax).

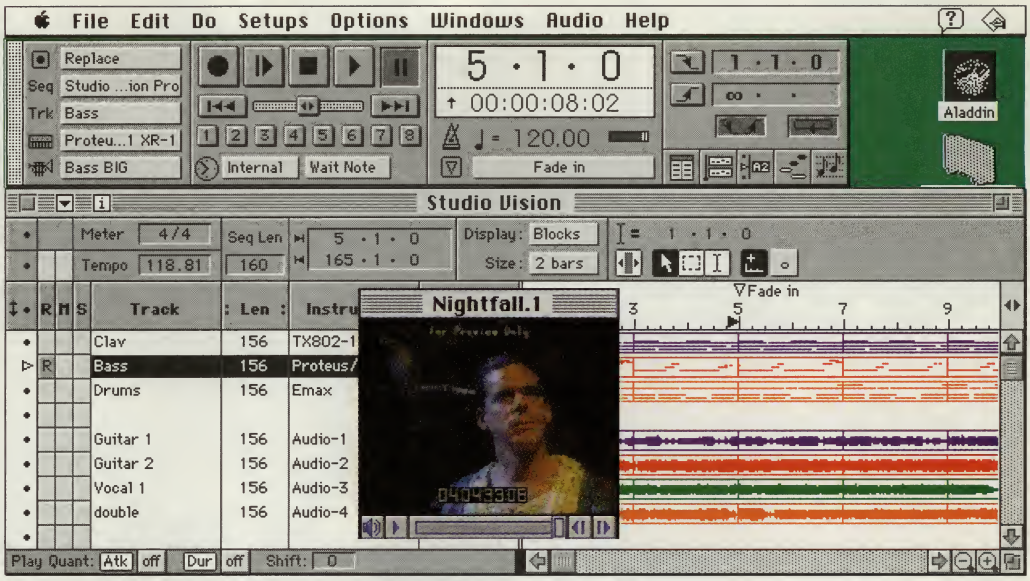
Planet Art Royalty Free Fine Art Collections

Planet Art has gone to the classics for its CD-ROM collections of royalty free fine art. The first available works are by Dürer, Michelangelo, Da Vinci, Doré, William Morris, post-impressionist-

French posters, Charles Gibson, the Book of Hours (late Middle Ages), Japanese Art, Medieval Alphabets, Icons, Architecture, and Arabic Tiles Navoi. Each volume contains 100 images in ISO 9660 and PhotoCD formats that can be opened and saved as TIFF, PICT, PCD, etc. files. Each CD is compatible with Mac and DOS/Windows platforms and sells for $89.99. Purchased in groups of three: $225.99. Through subscription: $59.99 monthly/$69.99 bi-monthly. Planet Art, 505 South Beverly Dr.; #242, Beverly Hills, CA 9022. 213.651.3405, 213.651.5473 (fax).

Graphics Boards

Matrox's latest entry into the fast expanding 64-bit graphics board arena is the MGA Impression Plus, a PCI board that includes high resolutions, fast refresh rates, and color depths with Windows support, as well as 3D and video acceleration. Using the MGA 64-bit chip with newly integrated 3D capabilities, the MGA Impression Plus is a 2MB VRAM board, upgradable to 4MB with an add-on module. It supports resolutions up to 1600x1200 in 8- and 16-bit color and a packed pixel mode of 1280x1024x24-bits. Refresh rates go up to 90Hz at 1280x1024 and 120Hz for 1024x768. With the addition of a 220MHz DAC, ultra-high refresh rates of 85Hz are available up to 1600x1200. Compliance with the Microsoft DCI API provides smooth video playback at resolutions up to 1024x768 at 24 frames per second. With the addition of the VideoXL add-on module, the Impression Plus supplies advanced video capabilities, including interpolation and scalability at resolutions up to 1280x1024 at 30 frames per second. The MGA PowerDesk Windows drivers shipped with the MGA Impression Plus allow easy installation, instant ModeSwitch for color depth and resolution switching, and Pixel Touch hardware zooming, among other features. Also shipping with MGA Impression Plus is the MGA 3D SuperPack, a CD ROM with games, 3D viewing files, and demos. The base price of MGA Impression is $449. Prices of the add-on modules are: $299 for the 2MB add-on; $149 for the VideoXL module, and $399 for the VideoXL with 2MB (the VideoXL modules will be available at the end of the year). Matrox, 1055 Saint-Regis, Dorval, Quebec, Canada H9P 2T4. 514.685.2630, 514.685.2853 (fax).

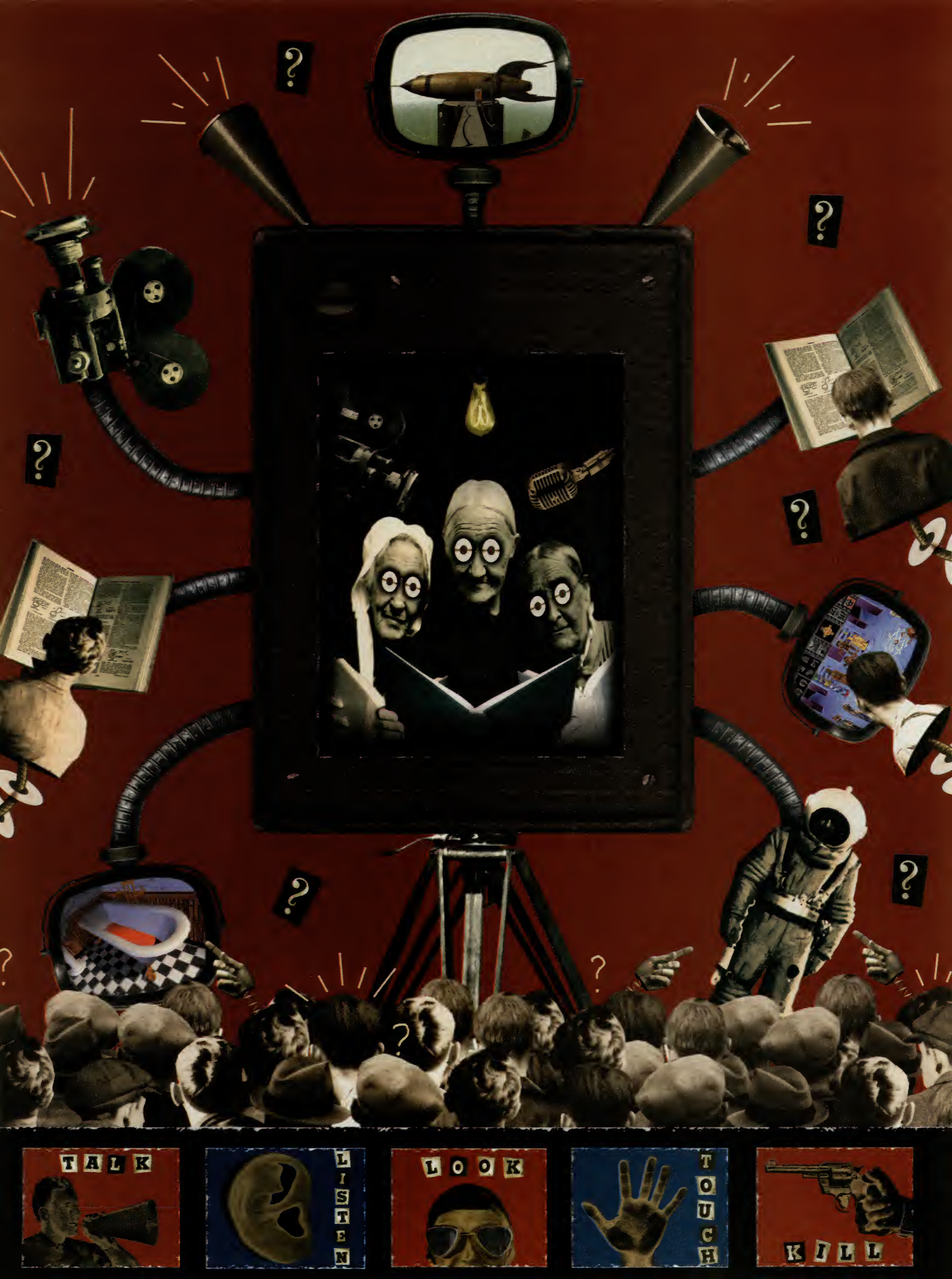


OPCODE MAX 3.0 AND STUDIO VISION AV

Max is a realtime object-oriented programming environment for producing customized applications, ranging from interactive music composition, to theater lighting and video control, to multimedia presentation authoring. **Max version 3.0** adds features such as the timeline editor, which allows users to program "temporally." Any patch in Max can become a track type and the timeline can send control messages to multiple instances of the patch. Timelines can be synched to SMPTE timecode, MIDI clocks, or internally, and can be controlled by other patches of timelines. Also included is a Max runtime player for creating double-clickable applications with no runtime licensing fees. Other new features include the ability to support digital audio playback from Digidesign cards, enhanced QuickTime and Sound Manager 3.0 support, and a debugger. Price is $595. Max owners can upgrade to 3.0 for $99. **Studio Vision AV** is a mid-priced version of Opcode's popular integrated MIDI sequencing/digital audio recording environment. Studio Vision AV supports 16-bit audio on the Macintosh 840AV, 660AV, PowerMac, and PowerBook 500 series computers, without need for additional hardware. Non-AV Quadras can run Studio Vision AV and produce 8-bit audio. The system includes full automated mixing of digital audio tracks, SMPTE synchronization to video via the Sound Manager, and non-destructive editing of digital audio and MIDI tracks. The latest version includes a QuickTime Movies Player to allow composition of music in Studio Vision AV while synchronized to a QuickTime movie. It requires 8MB of RAM, System 7, MIDI interface, and a large hard drive. Studio Vision AV is compatible with Spectral Innovations, NuMedia, and Digidesign's Audiomedia digital audio cards. Price is $595. Opcode, 3950 Fabian Way, Palo Alto, CA 94303. 415.856.3333, 415.856.3332 (fax).

Conversion Artist

Conversion Artist is a general-purpose tool for working with computer pictures. It acts as a bridge between bitmap images and Windows apps, and includes image editing tools, JPEG compression, color reduction, color correction, and a flexible screen capture utility. It will import and convert BIT, CE, CLP, DIB, HEX, IMG, MSP, PCX, RGB, TGA, BMP, CEB, CUT, GEN, IFF, LBM, PCC, PPM, RLE, WPG, TIFF, CEG, BMP, CVP, GIF, IMG, MCP, PCT, RAS, SVW, and WMF formats. Price is $99.95. Andover Advanced Technologies, 239 Littleton Rd., Ste. 2A, Westford, MA 01886. 508.392.1362, 508.392.0458 (fax).


TALK
LISTEN
LOOK
TOUCH
KILL

SEARCHING FOR INTERACTIVE FICTION

"Only at multimedia conferences can you get a round of applause for saying '**Content**.' Try going to a bookseller's convention and saying, '**The future is Content.**'"

— BRAN FERREN, **WALT DISNEY IMAGINEERING**

A little history. The motion picture was born in the last decade of the 19th century, mutant offspring of three different ideas: (1) persistence-of-vision toys like the Zoetrope and Praxinoscope, (2) still photography, and (3) the mechanized audience entertainment of the first arcades. "Mother" to this squalling infant was George Eastman, inventor of celluloid roll film. The father of record (an honor still disputed in some circles) was Thomas Edison, who cared little for motion photography, being primarily interested in supplementing his wax cylinder audio recordings with

BY CONNOR FREFF COCHRAN

ILLUSTRATION: JOHN UELAND

SEARCHING FOR INTERACTIVE FICTION

***Gabriel Knight: Sins of the Father* wins honors for flashiest celebrity voiceovers, including Tim Curry, Michael Dorn, Efrem Zimbalist Jr., and Mark Hamill, but loses crucial points for its heavy reliance on icons that distance you from the experience.**

a few nifty pictures. It took the bright people who worked for Edison, notably William Dickson, an immigrant Englishman, to see the economic power of the medium. It was Dickson who shot the first U.S. film on celluloid, Fred Ott's *Sneeze,* and put it in coin-operated peep show viewers called Kinetoscopes. This little wonder of cinema consisted of a single brief medium shot showing an Edison factory worker clearing his nasal cavities for the camera . . . and my God, how the money rolled in.

Next time the Academy Award broadcast mows you down, all sequins and self-congratulation, take my advice: Remember Fred Ott, and smile.

Fast forward. Here in the last decade of the 20th century, another new artform is being born: Interactive Fiction. Just as with motion pictures, the bouncing baby of I.F. is a hybrid mix of cultural and technological breeding stocks: one part computer, one part video, one part digitized audio, plus a fuzzy blend of contradictory storytelling traditions appropriated from novels, films, role-playing games, and television. "Mother" to this infant is the CD-ROM, while the would-be fathers are legion — a diverse batch of artists, techies, and businesspeople, unified in their urge to live up to (or at least profit from) the field's astronomical hype.

So what is Interactive Fiction? Is it a brand-new form of art that will eventually change the world as much as movies have? Is it just another techno-fad, the cyber equivalent of chrome tailfins and the hula hoop? Or does the truth lay somewhere between these extremes, with time the sole reliable measure of I.F.'s place in our future?

To explore these questions, I entered a state of Comparative Media Immersion, wallowing in CD-ROMs. What I did, while there, was look to sort out the rules.

Every creative medium has three sets of constraints: technical, cognitive, and structural. And each one of these constraints has an impact on the three-way relationship that exists between artist, work of art, and audience.

For an example of what I mean, let's start

At its introduction, *7th Guest* set a new visual standard for CD-ROM based games, and raised the expectations of game players everywhere. Those hungry for a more involving experience, however, would have to wait a little longer.

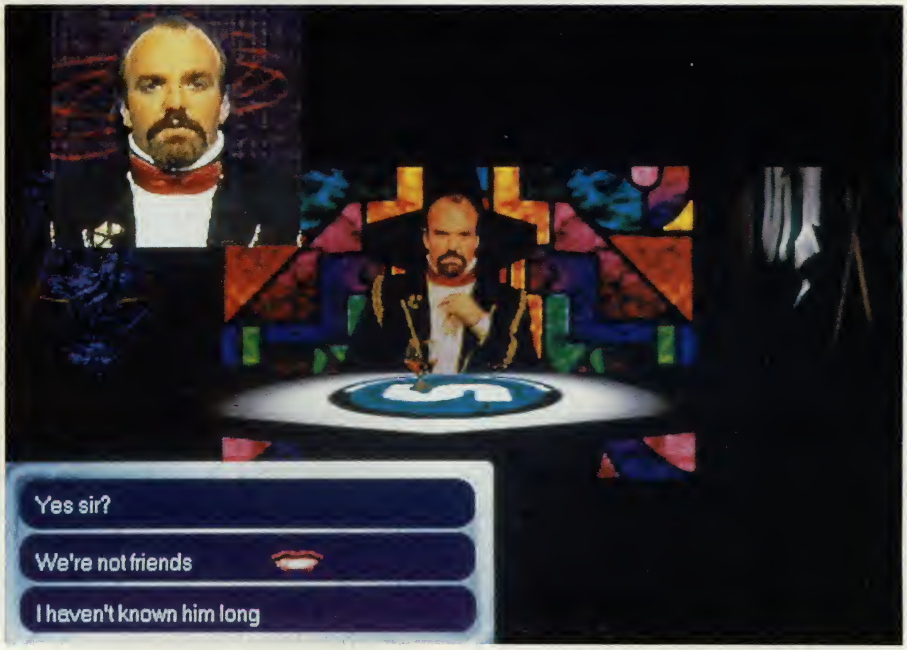
Grandma and Me **plays to the natural curiosity of kids (and adults for that matter), encouraging them to poke and prod the environment to see if it goes moo or buzz or clink or fly away or otherwise surprise and fascinate.**

with the familiar medium of "magazine" that you now hold in your hands.

The technical constraints that magazines face in 1994 are formidable. They are: flat, motionless images; generally no more than four-color printing; inks that smudge; paper that tears; and blocks of type that are always the same, no matter who reads them or how often they are read. (Magazines are not, in Marshall McLuhan's parlance, a very "plastic" medium.) The cognitive limits of a magazine are those set by human perception. We come to these pages pre-wired, biologically and culturally. We read from left to right across a line, from top to bottom of a column, from first to last of any article. Big, bright things catch our eyes; the more sensational the better. We tend to look at pictures first, captions or "knockout" quotes second, and the body of a piece last. Material that is ungrammatical or arhythmic puts us off. Letters that are too big are hard to hold together as sentences or words; conversely the eye skips over type that is too small, like a rock skimmed across the surface of a lake. These limits are very real, and while good writers and graphic designers can stretch the boundaries and make us enjoy it, we glaze over should their experiments go past the line. The third set of constraints — those limiting structure — are a kind of evolutionary record tracing a magazine's struggle to survive, to attract and hold a balance of readers and advertisers that keep it going from one issue to the next. You can track these constraints in a hundred subtle ways, but they are most obvious in the dead remains of magazines that didn't make it. (Just such an examination is what allowed Life magazine to resurrect itself as a viable newsstand-and-grocery-store monthly instead of a mainly-by-subscription weekly.)

The artist/artwork/audience equation is easier to visualize. Most people think of it as a line,

A maze of arbitrary puzzles and computer simulations lead the hapless wanderer through the world of *Quantum Gate*. Things look great and the puzzles are entertaining, but the pieces don't hang together as cohesive interactive fiction.

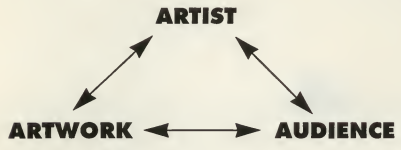


SEARCHING FOR INTERACTIVE FICTION

like so:

ARTIST → ARTWORK → AUDIENCE

But that's wrong. It's really a triangle, like this —



— with each vertex of the triangle having its own unique relationship to the others. A wider awareness of this truth would save us all a lot of grief.

In light of these constraints and relationships, the current state of Interactive Fiction is fascinating. We all know what a novel is. We all know what a sitcom is. We all know what a movie is. Each of these, in its own way, is a richly developed and deeply involving form. But nobody yet knows what Interactive Fiction is, especially not the people who sell it. That much becomes obvious when you walk into a software store and see *The Lawnmower Man*, *The 7th Guest*, and *Grandmother and Me* side by side on the same shelf. No bookstore would put Stephen King next to Stephen Hawking just because their names differed by a single syllable. Yet with I.F., things are still that confused.

It's tough to blame the stores, though, when even the creators can't agree.

During my immersion I spent time with the programs listed above, plus *Myst*, *Gabriel Knight: Sins of the Father*, *Quantum Gate*, and Ebook's *Aladdin and the Magic Lamp*. That's seven programs, each of which claimed, in some fashion, to be Interactive Fiction. But no coherent picture emerged from the experience. I was overwhelmingly reminded of the days of Fred Ott's *Sneeze*, of the time in film history when something could be interesting just because it was new, rather than good.

Talent was not the issue; talent was on full display. But artistry? Emotion? Imagination? Chutzpah? These were sadly hard to find. With only two exceptions, none of the fictions I explored met the true test of art; i.e., making me feel something. Were they entertaining? Yes they were. But "entertainment" is the high fructose corn syrup of art; without something more in the mix it's just so many empty calories. The real trick is to entertain and involve. This is the test that every form of art faces when it encounters an audience.

Bottom of the barrel was *The Lawnmower Man*, designed by Sales Curve International and distributed by Sony Electronic Publishing. I would feel kinder toward it if it hadn't deliberately set me up. The scenario described by the accompanying booklet is derivative but potentially compelling. It picks up the storyline mere seconds after *The Lawnmower Man* movie ends, with CyberJobe pulling all his human enemies into the electronic world for some sadistic fun and games. As the hero, Dr. Angelo, you must save your friends, the world, and yourself, in that order. Cool. Only when you start to run the program you discover that the booklet's talk of "story" is a vast exaggeration. In truth you are in a fancy 3D arcade-style zap-'em-up, with gorgeous graphics but no more wit, intelligence, or interactivity than a round of *Mortal Kombat II*. Less, perhaps. The only "fiction" here is the claim that this is, in any way, fiction. Next!

> Entertainment is the high fructose corn syrup of art; without something more in the mix it's just so many empty calories.

Quantum Gate is designed by Hyperbole Studios and distributed by Media Vision. "Hyperbole" is right. Everything about *Quantum Gate*, right down to the author's bio, is slightly overblown. (Did I say slightly? "Director, playwright, actor, and novelist Greg Roach is considered one of the world's leading interactive filmmakers.") This delusion of grandeur would be easier to stomach if the *Quantum Gate* experience filled its creator's self-billing, but it doesn't. In fiction, story is king — and there is no real story here, just a hash of mismatched story elements. By 2057, decades of wasteful behavior and pollution have led Earth to the brink of eco-catastrophe. But you, as a brave, newly-recruited soldier, can work your way through an arbitrary maze of puzzles and computer simulations and save the Earth by retrieving sufficient "iridium oxide" from an alien world which we just happen to be able to reach (lucky us!) using the Quantum Gate of the title. Along the way things certainly look great, and yes, the puzzles are entertaining. But it's just more of the same in a glitzier wrapping, and the pieces don't hang together. Greg Roach's earlier product, *The Madness of Roland*, was far more innovative at its core.

Ebook's *Aladdin and the Magic Lamp* calls itself a "multimedia storybook," and aims at teens and younger audiences. It truly is a storybook, with pages of art and text showing up on the screen as a female narrator reads to you over ongoing music. Every now and then some video pops up in the form of a tiny headshot of an actress portraying Scheherazade, the teller of the tale. Unfortunately, this is entirely out of keeping with the rest of the story's "look." I found that each sudden appearance would knock me out of my involvement. (It didn't help that the graphic design made her seem like a video kiosk in a Persian rug store.) There is some interactivity here, but it is rare and quite limited in scope. Its first appearance comes when Aladdin sees a pear, an orange, and an apple in a street vendor's display. You get to select which he takes, and — briefly — the storylines diverge. But they rapidly come back together onto the main track, and don't diverge again for some time. After a while I found myself wondering why they even bothered, aside from the fact that the word "interactive" looks great on the box.

Gabriel Knight: Sins of the Father, from Sierra, wins honors for the flashiest voiceovers, including Tim Curry, Michael Dorn, Efrem Zimbalist Jr., and Mark Hamill. It was also remarkable for putting its writer, Jane Jensen, on the box. Jane is one of the people struggling with the possibilities of the medium, but she is still stuck deeply in the interactivity model developed for computer-based role playing games. The interface is awash in icons. There is a WALK icon you

***Myst*, like *Grandma and Me*, takes the first steps toward defining the paradigm of interactive fiction by inviting you to explore a bizarre island not to win a prize or save the world or score more points, but for the intense experience.**

press to make it possible to direct characters around the screen, and a LOOK icon to call up descriptions of items in an environment, and an ASK icon to let you interrogate someone, and a TALK icon, and a PICK UP icon, and an OPEN/CLOSE icon, and an OPERATE icon, and . . . well. What this approach offered in control it more than lost, for me, by distancing my involvement. I felt like I was operating heavy machinery. (Imagine watching a movie this way!) For all the vocal and artistic talent involved, the characters never became real for me. At least Jane and company tried, though, especially in providing multiple-branched dialogs, and I'd like to see what they could do if cut free of their role-playing and puzzle-solving paradigms.

The 7th Guest was designed by Trilobyte and is distributed by Virgin Games. Someone in marketing had the sense to refer to this as "interactive drama" rather than fiction, and the subtle distinction is valid. This isn't a story. It's a fairly standard puzzle structure used to present a collection of dramatic visual setpieces. As for involvement, we're still in the land of icons — a wagging skeletal hand to say that no action can be performed in a given location (wouldn't that be a great thing to have in real life?), a throbbing exposed brain inside an open skull to indicate a puzzle that needs to be solved, and so on. This creation set a new visual standard and sold a lot of CD-ROM drives to consumers, so it deserves a footnote in I.F.'s history. But there is nothing about it which is structurally innovative.

Though *The Lawnmower Man* began as a Steven King story and became a fairly lackluster movie, its present incarnation as an arcade-style zap-'em-up CD-ROM game offers gorgeous 3D graphics, but little in the way of story or involvement.

The two best I saved for last. They were the only ones that offered me a sensation I've never felt from a movie or book or play — a fact which might point in a direction that Interactive Fiction is uniquely suited to explore.

But I'll come back to that. The programs, first: *Myst*, designed by Robyn and Rand Miller and Cyan and distributed by Broderbund; and Mercer Mayer's *Grandmother and Me*, from the Living Books imprint of Random House/Broderbund.

The two of these couldn't be any more different in appearance, or any more similar at their center. *Myst* is moody and mysterious and more than a little frustrating. *Grandmother and Me* is easy sweetness and silly laughs incarnate, the perfect experience to share with a child (or just the child inside you). In *Myst* you begin alone

Continued on page 35

THE BLACK ART OF BRINGING PIXELS TO LIFE

AN OVERVIEW OF THE TOOLS & TECHNIQUES OF CHARACTER ANIMATION

BY GREGORY MACNICOL

Movie makers create virtual worlds, times, and places that in many cases never existed and never could. We love to explore their fantasies with them — as long as they're believable. Think about it. When was the last time you weren't sure if a character was real and alive or a digital fabrication? This kind of delightful illusion made Speilberg's *Jurassic Park* into a visually believable experience. The combination of the probable — or improbable — when

ILLUSTRATION: DAVID BECK

CHARACTER ANIMATION

wedded to hyper-realism, is absolutely compelling. Likewise, the technology and artistry that combines to accomplish creations like grazing ornithopods is inherently interesting too — it's no easy task to breath life into extinct creatures. On-screen realism is what happens when skilled animators get access to superior digital tools.

Regardless of the creature animated, it's nuance of character that makes a creature come to life. It used to be that character animation was a painfully arduous business and required frame-by-frame control. That was then. Using today's tools, professional animators can produce characters that reveal virtually no clues to their genesis — indeed life-like creatures can now be completely fabricated by the "hands" of the computer. From Saturday morning cartoons to feature films, the line separating real characters from digital facsimiles is blurring.

So-called "character animation" has always been a challenging craft. Our eyes are quick to notice telltale flaws that detract from the illusion we are witnessing as a credible semblance of reality. As the English poet Samuel Coleridge observed, to appreciate a story regardless of medium, we (the audience) must "willingly suspend our disbelief." A momentary lapse on the part of the animator can make this suspension nearly impossible. For example, an inadvertent seam in an otherwise believable actor's neck, or a gravity-defying movement in an otherwise perfectly formulated alien can shatter the illusion.

Earlier generations of Disney-style 2D animators demonstrated a superior methodology that inspired characters with lifelike movements and qualities. Subtle details like the posture of the head and the movements of the eyes are essential elements in characterization. These are artistic observations that infuse characters with distinct personalities — their delineation is entirely dependent on the artistry of the animator. And so it was in all the early Disney animated features such as *Snow White* and *Bambi* up through *Lady and the Tramp* where, for each production, a team of animators was entirely responsible for the 2D motion — and emotion.

But since then, mainly as a result of advances in computer display speed, animation studios — Disney included — now use sophisticated hardware and software tools to provide rapid and seamless character animation for films such as *Aladdin* and *Beauty and the Beast.* Indeed, the new computer technologies have allowed a number of studios to commit to a whole new generation of digitally-based animated movies.

Not only does the new computerized technology speed the animation process, it provides a whole array of sophisticated new tools that enable the development of unique and sometimes surreal visions. Anyone who saw *Lawnmower Man* has some idea of the capabilities we're talking about. In this feature, Angel Studios was able to transform a simple kiss of virtual bodies into a visual extravaganza, catapulting the participants conjoined in a throbbing prenuptial blob that hurtled down a revolving vortex.

Another similar and now ubiquitous effect called *morphing* allows the characteristics of two sometimes very dissimilar objects to be blenderized into a composite image. We see this all the time now in TV commercials with blatant examples such as an automobile growing organically into a cougar before our eyes. On a more subtle level, feature films increasingly rely on digital stand-ins — morphed characters placed in positions where real actors never existed.

Using the new generation of high-tech tools, creating effective animations is a lot easier than it used to be. Superior tools are available and most of them run on ordinary PCs. So what's it take to harness all this computing wizardry? Do you just click on an icon or select an item from a pull-down menu? The short answer is yes . . . and no. So let's look at what it takes to breath life into an otherwise wooden catatonic character.

ADDRESSES YOU NEED TO KNOW

Acclaim
71 Audrey Ave.
Oyster Bay, NY 11771
516.624.8888
516.624.2871 FAX

Alias
110 Richmond St. East
Toronto, Canada M5C 1P1
416.362.9181
416.362.0630 FAX
Power Animator (SGI) $15,000, includes Alias Motion Sampler.
Animator (SGI) **$6,995.**
Upgrade to Power Animator $8,000.

Autodesk
2320 Marin Ship Way
Sausalito, CA 94965
415.332.2344
415.331.8093 FAX
3D Studio (PC) $2,995.

Caligari
1955 Landings Dr.
Mountain View, CA 94043
415.390.9600
415.390.9755 FAX
trueSpace (PC) $795.

Hash
2800 E. Evergreen Blvd.
Vancouver, WA 98661
206.750.0042
206.750.0451 FAX
Playmation (Mac, PC, Amiga) $349.
Animation Master (Mac, PC) $699, (SGI) $999.

Macromedia
600 Townsend St.
Suite 310W
San Francisco, CA 94103
415.252.2000
Life Forms (Mac, SGI) $495.

Silicon Graphics
2011 N. Shoreline Blvd., Bld. 5
Mountain View, CA 94039
415.960.1980
415.961.0595 FAX

SimGraphics
1137 Huntington
South Pasadena, CA 91030
213.255.0900
213.255.0987 FAX

SoftImage
3510 Boul Blvd.
St. Laurent, Suite 500
Montreal, Quebec
Canada H2X 2V2
514.845.1636
514.845.5676 FAX
SoftImage (SGI) $7,000-$55,000.

Vertigo
842 Thurlow St.
Suite 300
Vancouver, BC
Canada V6E 1W2
604.684.2113
604.684.2108 FAX
Vertigo Animation Machine (SGI) $4,995-$15,995.

Wavefront
530 E. Montecito
Santa Barbara, CA 93103
805.962.8117
805.963.0410 FAX
Kinemation (SGI) $15,000.

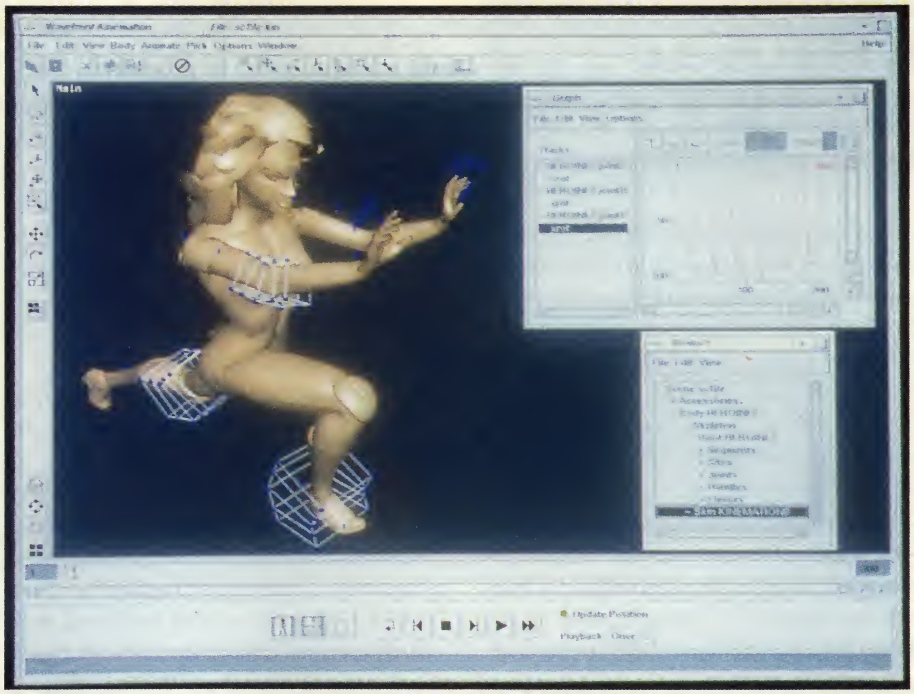
The Right Moves

"Classic" pre-computer 2D animators relied on a series of character sketches called *keyframes* that delineate a character's position in space and time. They provide a foundation of illustrations that describe particular moments at regular intervals in an animated sequence. All the frames

between two frames were typically filled-in by less senior animators, called *inbetweeners*. In the 3D world, the process is almost identical. The big difference is that the role played by the junior animator is now played by the computer, which interpolates and then generates the sequence of frames between keyframes — a process called *tweening*.

Keyframing can be painfully slow and arduous for a complex animation. Yet using today's most advanced digital 3D animation facilities, generating keyframes is still the preferred method. Why? Mainly because of character. In an effective animation, subtle nuances of character constantly provide the viewer with information about characters in the story.

Take, for example, the following relatively simple sequence: A young man does an about-face, stares out into the foreground, and his hat falls off. These motions can best be simulated by slowly articulating each and every detail of the turn, the hat as it falls. The elaboration of revealing little details (such as a left eyebrow that moves sooner than the right) add subtlety and depth to a scene. The little telling quirks of gesture and posture that make or break a



Wavefront's Kinemation software runs on SGI platforms and features inverse kinematics functions that are compatible with Acclaim's motion capture technology for character animation. Kinemation also includes Smart Skin, a feature that allows muscles to bulge, swell, and crease automatically.

Effective character animation requires sublty and nuance beyond what can currently be automated and modeled by today's highend animation systems, though a number of companies are working on systems to generate character traits and moods algorithmically. In this commercial for BonCafe by the Moving Picture Company, note how every element of the tiger cup, from the flopped ears to the peak of its eyebrows to the set of the jaw adds something to its personality.

scene are the kinds of details that are impossible to automate and program into lifelike characterization. And so, just as in the now-antiquated 2D world, skilled animators are required to convey the emotional content of a character. Fortunately, the junior animator, i.e. the computer, takes on the drudgery of repetitive operations and stores the results in a sequence that's tape- or film-ready.

Computers have taken a lot of drudgery out of the process, but there are still numerous areas where animators could use some help. For instance, it would be a lot easier to animate if you could tell the computer to, say, turn the character to the right, wait a second, and then have her walk ahead for 30 feet. This elusive capability is called *goal directed animation*. You would simply type in the commands and the character would perform as directed. But as you might imagine, ambiguity has a way of intervening in unexpected ways. Even with the best artificial intelligence programming, the method has proved undependable.

It turns out, at least for the time being, there is no substitute for the skill of an experienced animator. When it comes to providing those subtle details that result in a believable character, the computer is simply not observant enough. Creativity is virtually impossible to program.

This is not to say that the computer is not fantastically capable. In fact, some of the methods pioneered by early classic animators are now being integrated into everyday digital animation systems. For example, in order to recreate the lifelike movement of animals, Disney animators shot motion pictures of animals. To prepare for *Bambi*, they filmed a deer under various conditions and scrutinized its every movement in slow motion. Then with the mechanics in mind, they went to their animation stands and replicated the animal's motion as realistically as they could. Likewise with character: The exact motions of characters are filmed and then followed to replicate suitable postures and actions.

In the digital world, a version of this process is called *forward kinematics*. An excellent example of this technique was a show-stopper at the last SIGGRAPH. Acclaim Entertainment, a game manufacturer, had set out to demonstrate the realistic action of a game they were working on. Their demo portrayed two characters fighting. One was a muscle-bound human, the other character, bigger and uglier, was of alien parentage. The fighting sequence, which included numerous slips, falls, and blows, was remarkably accurate — particularly because of the nuances that the actors inadvertently brought in.

The Acclaim animators were able to accomplish astounding realism by capturing the motion of electronically wired actors who performed a choreographed mock fight. The actors' motions were tracked using a 3D digital tracking system — 3D sensors were strategically placed throughout the room beforehand and the digitized motion sequence, based on the sensors on the actors' bodies, was later extrapolated to the two 3D generated characters. The animation was then rendered on video using Autodesk's 3D Studio with extraordinary realism. The faces were well executed and the superior motion was further enhanced by convincing shadows.

The drawback of forward kinematics systems is that once motions are recorded, the sequence is fixed and difficult to change. In order

VActor ANIMATION SYSTEMS PRICE LIST

The following is excerpted from a price list sent to us by SimGraphics. Rather than simply quote a couple of prices, we thought we'd show you virtually the entire document (though we've reformatted it for publication). The prices and systems were current as of September 1994. They're presented here to give you an idea of both the costs and the configurations of highend, realtime performance animation systems. For more information, contact SimGraphics.

VActor Software/Hardware Input Options

VActor Performer/Standard Input Device Package: $70,000

- VActor Performer software
- Standard Input Device Package:
  - Face Waldo
  - Encoder box (16 channel)
  - Digital Footpedal
  - Digital Joystick
  - Digital Slider
  - Isotrack II 3D sensor
- Users manual, travel cases

VActor Performer/Multi-Trax Face Input Package: $145,000

- VActor Performer software with Multi-trax support
- Multi-Trax Input Package:
  - 2 Multi-Trax Cameras
  - 486 PC
  - PC Recording & Sorting Software
  - Calibration Frame
  - Encoder Box (16 channel)
  - Digital Footpedal
  - Digital Joystick
  - Digital Slider
  - Isotrack II 3D sensor
- Users manual
- **Optional:** Additional Camera & Software Support: **$25,000**

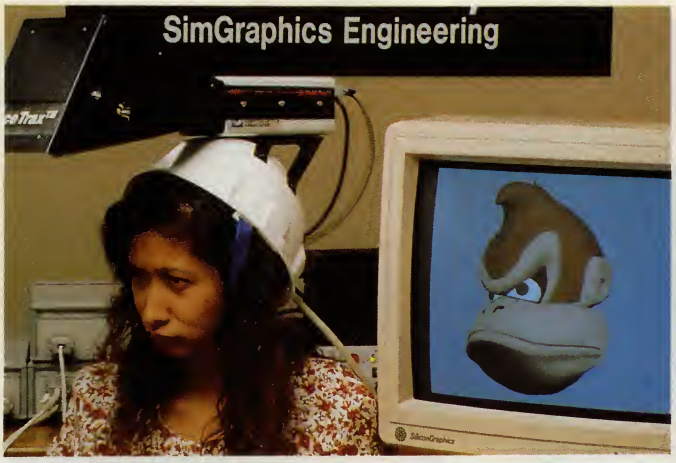
Magnetic Full-Body Input Option: $30,000

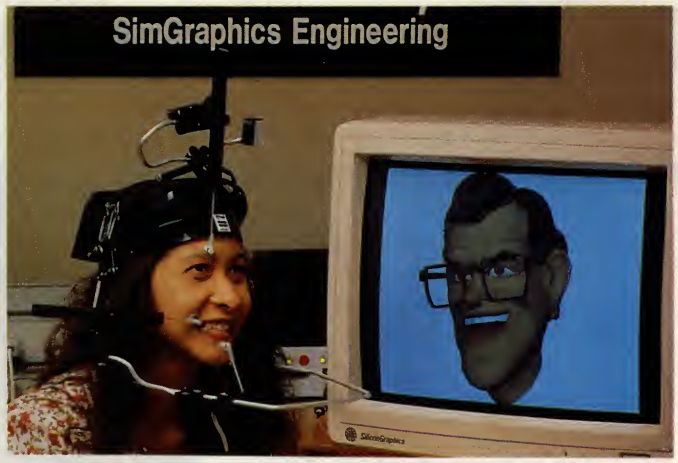
- 3 Polhemus Fastrack units with 12 sensors
- VActor/Polhemus software drivers

Hand Input Option: T.B.D.

- Hand support available but negotiated separately due to parts availability

Multi-Trax Full-Body Input Package Not Yet Available





In comparison with capturing body motion, capturing facial expressions is much more complicated. At left: SimGraphics' FaceTrax, a $22,000 optical reader developed by Adaptive Optics Associates, being used to control a computer-generated cartoon character in realtime. Right: FaceTrax Waldo, a $10,000 device co-designed by SimGraphics and the Character Shop, uses mechanical linear encoders that attach to your face. SimGraphics' Steve Glenn reports that the systems yield about equivalent results, though FaceTrax is much easier to use.

to make a major change in the fighting scene, the animators would need to re-choreograph, re-enact, and re-record the motion sequence. Changes based solely on forward kinematics are therefore costly.

A cousin to forward kinematics is *inverse kinematics*. Tools based on it are now available for use with most computer animation programs. Inverse kinematics recognizes the primacy of certain implicit relationships that apply to objects. For example, hierarchical kinds of relationships are implied in human physiology. The hand is connected to the arm and the arm to the shoulder. When the arm is moved the hand goes with it. In effect, the computer can be made to understand that the various parts of the body are linked together, and using these tools you can move a hand and the hand will, in turn, move the arm in the correct way.

The correct way must be defined, of course. Rules must be set up so that when a connection

VActor Producer
Not Yet Available

SYSTEM REQUIREMENTS:

Silicon Graphics Indigo 2 Extreme, Crimson VGX, VGXT, RE, or Onyx VTX, RE2

COMPLETE PACKAGES:
VActor Software/Hardware Input/Silicon Graphics Computers

Performance Package $105,000
(includes $5,000 discount)
- VActor Performer/Standard Input Device Package (see above)
- Silicon Graphics Indigo 2 Extreme w/32 meg RAM, 1 gig storage, 19" monitor

Premier Performance Package: $160,350
(includes $10,000 discount)
- VActor Performer/Standard Input Device Package (see above)
- Silicon Graphics Crimson VGXT w/64 meg RAM, multibuffer upgrade, 1.2 gig storage, 19" monitor, VideoCreator Board

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TERMS
- 50% downpayment required, net 30 on outstanding balance with approved credit. FOB, South Pasadena.
- Prices are in US Dollars. Sales Taxes not included. International pricing may be higher. Complete Packages (with Silicon Graphics computers) are available in US only. Prices subject to change without notice.
- Three days training included with price. Support/sevice contract additional.

VActor Development & Lease Costs
Custom VActor Development

Simple Character: $15-30,000
- Examples: Head, simple body with pre-created motion, simple morph.

Complex Character: $30-50,000
(Complex body, complex morphs, special effects)
- Examples: Complex body with user-defined motion. Complex morph, Special Effects

NOTES: SimGraphics can create VActors based on any character, mascot, logo, and/or product. Price ranges listed detail costs required for the development of custom VActors based on client supplied artwork. VActors can include object-to-object morphing and other effects. VActors take six to eight weeks to create after the submission of line art. Rush orders entail additional costs. VActors require VActor Performer software and hardware input devices for performance or production work.

"Ratz" VActor is the co-host of BBC's "Live and Kicking" and "Children's BBC." He was developed by TeleVirtual Ltd. and SimGraphics for the BBC. He's one of the first live, computer generated characters to appear on television.

is rotated past a particular angle, it actuates the next component in the link. On the simplest level, many of today's animation programs provide linking that joins objects to one another. But because the linking is rule-based and very fallible, the tools still depend on an animator to determine when a position is excessive or unnatural and what's to be done about it. Inverse kinetic tools are great labor savers but still require the careful attention of the animator if they're to be used effectively. After the hierarchy is set up and the rules are in place, more emotion-revealing details can be added with greater ease because of the automated movement.

The next level of digitally-assisted animation is still being explored in computer research labs. Techniques to orchestrate advanced hierarchical relationships vis-á-vis the various body parts are being developed. Ultimately, like a director calling out to his actors, the animator will be able to write scripts that will be performed by virtual actors. Need more emotion? No problem. The actor will simply be instructed to, say, accentuate a walk thereby conveying a different sort of feeling. This kind of system, however, implies a complex and sophisticated language of motions. While it may ultimately speed animation, its success still depends entirely on your ability to manipulate and artfully articulate the meta-language.

Take Two

An element common to all animation is the continuity of the basic process. An animated sequence is first scripted, then rendered, and finally viewed for editing. Later, after editing changes have been incorporated, the animation is re-rendered for viewing and further critiquing. This process is repeated until all the motions are perfected. Because it is such a complex time-intensive process, the key to successful commercial animation is the ability to see and edit quickly. This requires fast preview-level rendering (of a lower quality) and displaying the motion as it will be seen. That's why fast rendering and immediate storage and access on some kind of digital disk recorder has become a common professional practice. These days digital encoding equipment has become inexpensive enough that even novices on modest budgets can afford it. Low-cost PC and Mac-based systems are available equipped with video compression boards that allow realtime playback of digital animation files. Animated sequences can be run backwards, forwards, or slowed down for examination and editing.

Fast Forward

All animations require imaginative and detailed planning. In the best of all possible digital worlds, an animation system would allow you to move your characters in real time. Is this just pie in a digital sky? Not really. As computer graphic systems run ever faster, this has become a realizable fantasy. A new technique, pioneered about five years ago, is called *performance animation*. This technique relies on an animator, now called a puppeteer, who controls a device that moves a computer generated character — in real time. The physical actions of the puppeteer guide and control the actions of a synthetic character that's viewed on a video monitor.

Typically, in this state-of-the-art scenario, the typical hardware employed is a Silicon Graphics Crimson, though the minimum hardware is an SGI Indigo 2. Check out the table on SimGraphics' performance animation gear and you'll see that even the "minimum" Indigo 2-based system is priced in the stratosphere. But after repeated performances, such a setup quickly pays for itself, as you can see from their inhouse character development rates.

An excellent example of performance animation was featured in a French TV series for children. *Mat le Fantome* (Mat the Ghost) was a live animated character. He interacted with the host, talked, changed costumes, moved about, and instantaneously metamorphesized into other characters — and all in real time. In this kind of serial production application, the comparable cost of creating, moving, and rendering make a realtime animated character more cost-effective after only a few episodes.

Slower, not-so highend systems could be used in performance animation if serious compromises such as using wireframe images to record the keyframes were made. After the performance was recorded, details would be added to the wireframe, and the entire scene would have to be rendered frame by frame. Which, if you're using a less industrial-strength computer — say a Quadra, 486, or Amiga — could be a very time-consuming and ultimately costly process.

As you may expect, it takes more than one person to make Mat come alive. Several puppeteers donning head, hand, and foot gear are required for Mat to make his lifelike appearances. Shades of Mat the Ghost are materializing on TV and will soon will be commonplace. Indeed, a more adult example was recently created by Colossal Pictures. *Moxie* is a "way far-out dude" who interacts with a live audience. The actor/comedian/puppeteer who is stationed off-screen interacts directly with audience members. The characterization is so believable that Moxie now serves as regular live digital host for the Cartoon Network.

Want to get in on the act? If you're hanker-

Continued on page 29

INVERSE KINEMATICS • STEP-BY-STEP

BY DAVID POOLE

Inverse kinematics is a type of 3D animation scripting that enables you to quickly and easily animate the motion of arms and legs of articulated characters. The term literally means to invert the use of kinematic chains (see Figure 1). A kinematic chain is a heirarchical structure that simplifies the control of animating the various parts of a heirarchy. A heirarchy is simply a structure that is built of child-parent relationships, such as a foot being child to an ankle, which is child to a shin, and then a knee, thigh, hip, etc. Functionally, when you animate with inverse kinematics it's as easy as dragging a character's foot across the screen and the rest of the leg will respond in turn.

The examples shown here were created with SoftImage Creative Environment.

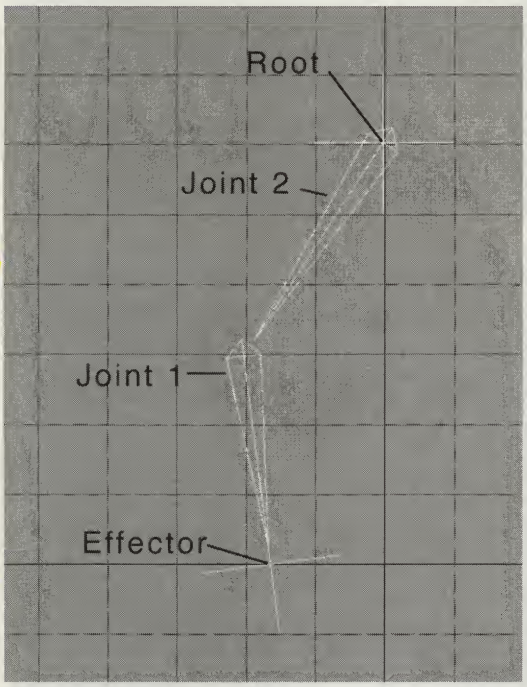


Fig. 1. A typical inverse kinematics skeletal chain. 3D models or parts of 3D models are attached to the chain root or joints in such a fashion that when the effector is moved, the rest of the chain moves in relation to the effector, allowing easy positioning of a variety of arm and leg positions for character animation.

Fig. 2. These two images show different poses for a robotic type structure. Although there are many pieces making up the legs of the character, they have been appropriately connected to the root and joints of the inverse kinematics chain so that when the foot is moved, the shin, knee, thigh, and hip know how to respond accordingly.

Continued

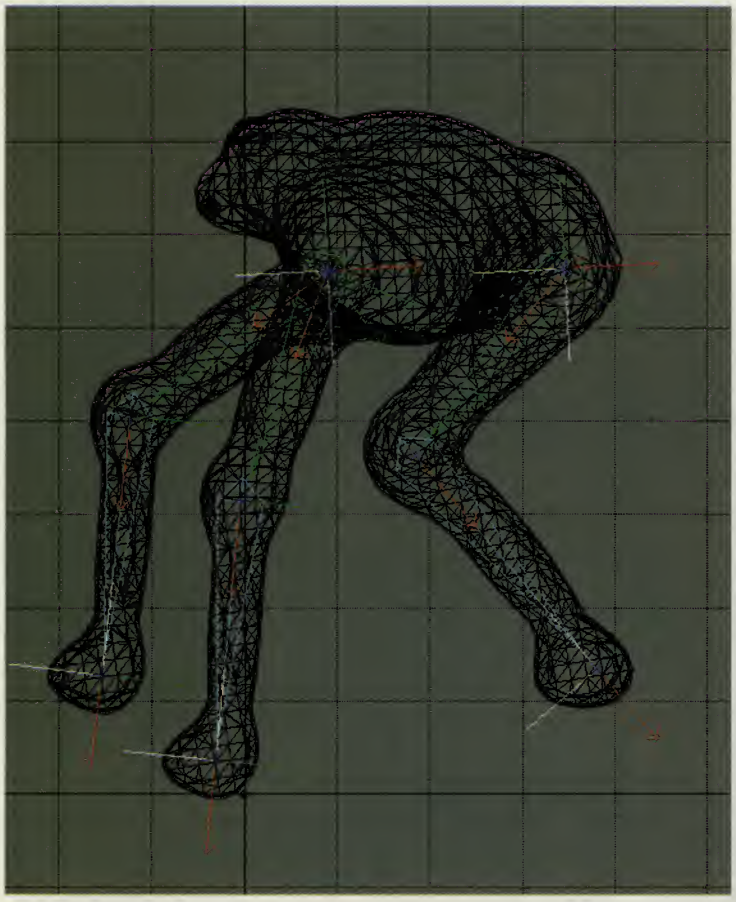


Fig. 3a

Fig. 3b

Fig. 3c

Fig. 3d

Fig. 3. These images show how inverse kinematics can be applied to more organic forms, such as animals. The three-legged creature is made entirely of a single, polygonal mesh (3a), and while there are actually three kinematic chains tied to the creature (a), the various points on the mesh are allocated in such a fashion as to enable each leg to be animated separately (b, c, d).

CHARACTER ANIMATION

Continued from page 26

ing for a leading edge performance vehicle, the tools are available — for a price. SimGraphics, a pivotal player and pioneer in the performance animation market, markets VActor Producer, a system that allows scripting of several virtual actors (see the sidebar on page 27). This same hardware/software system was used for creating "Ratz," a realtime character featured in a recent BBC series. Similar techniques are being considered for creating digital actors for Lucasfilm's sequel to Star Wars.

Character Animation for the Rest of Us

As the chronically restless innovators in the computer animation industry continue to take on new and ever more daunting projects, the resulting technologies gradually percolate down to the rest of us in refined and more or less affordable packages. Enough time has transpired so that a considerable wealth of digital tools and techniques is available even in the less expensive entry level software programs that are available to PC users. Let's start with the workstation market and work our way down.

Wavefront is a company that has responded alertly to the demand for advanced character animation with several tools designed for use with Silicon Graphics workstations. Their Kinemation package integrates forward and inverse kinematics for primary character control. The 3D joint action is completely controllable and incorporates mobility limits so that knees, for example, won't hyper extend unnaturally. The software is directly compatible with Acclaim's data set so that motion data is easily importable.

As an alternative to learning and using the Kinemation package, Wavefront and Acclaim set up performance animation centers in a number of cities (Palo Alto, Minneapolis, New York, Paris, Santa Monica, and Oyster Bay) as a service to animators who need this data but don't have a large budget or an appropriate facility. What you get is a dataset of the characters' actions. All you have to do is add the characters who now have something to move to. Kinemation also includes a novel feature called Smart Skin that allows muscles, for example, to bulge, swell, and crease automatically. And when this feature is used with Wavefront's Dynamation package, you can add blubbery fat and mass, or give them complex attributes common to smoke, fire, water, or special effects.

Alias, another star in the computer animation business, provides several capabilities in their Animator package. Their inverse kinematics capability is based on full 3D control, and includes control over the type of constraints imposed. The system also supports the control of the skin of the character providing a seamless surface. For additional control over movement, their Cluster capability allows detailed smooth control over the motion of the interaction of the characters and character parts. According to Phil Neray, of Alias, Clusters was used extensively in *The Flinstones* for creating Dino and other creatures. Alias' motion scripting and Alias Motion Sampler performance animation system is advanced and complete. For example, Windlight Studios, who created the TV primetime pilot, *Weldon Pond*, relied completely on the Alias animation system for all of the animation of the lead role — a talking sheep.

SoftImage, another SGI-based package many consider to be the prime character animation tool, supports inverse kinematics (see David Poole's sidebar on IK, produced in SoftImage) and lattice editing — an effect wherein a grid is imposed on an object, and any point along intersecting grid lines can be clicked and dragged, distorting the figure. Latticing has been used to great effect in *Death Becomes Her*.

A low-cost SGI-based animation package from Vertigo also provides sophisticated capabilities. Characters can be assigned mathematically-based animated functions, such as applying a noise to a character to simulate shivering. The motions can be dependent, relational, or purely mathematical. Vertigo also includes what they call Effectors. Examples include magnets, waves, wind, twists, and so on. These effects automate common and uncommon squash and stretch characteristics. All of these effects are separate files that can be changed independently.

If you're on a really tight budget, many of the same software tools used by professional animation studios are available in relatively easy-to-use software packages. In other words, you now have access to most of the essential technological tools and digital shortcuts necessary to create believable relatively sophisticated characters.

On the PC platform, animation programs, such as Autodesk's 3D Studio, support hierarchical linking so objects can attach to each other. This keyframe-based animation system provides linking on a model basis or in the animation so that one object can be set to control another, and the latest release includes inverse kinematics.

Animation (Playmation), from Hash, is another 3D animation product that lets you create and edit natural shapes typical of faces and bodies. Instead of using polygons, it uses splines, which create perfectly round surfaces. Playmation runs on Mac and Windows platforms and supports cross-platform file formats. The Amiga version is no longer being developed, though a limited number of copies are still available. Animation Master is a highend version of Playmation that includes inverse kinematics, materials editors, and several output types (motion blurs, field rendering, shadow buffers, and depth buffers) in its rendering module. Animation Master is available for Windows, Mac, Power Mac, Power PC, Windows NT, and SGI platforms.

Caligari's PC-based trueSpace is a complete 3D animation system that also supports splines. It can also read Wavefront files — an unusual capability that allows it to read performance animations generated on SGI machines. Lightwave, which is bundled with the Video Toaster, is the primary 3D animation program used in the TV series *Seaquest*. Lightwave is used for creating some of the "characters," such as sharks, who are made to swim and undulate believably.

Life Forms, developed at Simon Fraser University and distributed by Macromedia, was originally designed as a digital choreography tool. It allows the manipulation virtual bodies with built-in constraints consistent with human anatomical limitations. External forces such as gravity can be turned on and off creating some rather interesting effects. Figures can be edited and a character shape library is included. The software contains hooks for use with other Macromedia products, including Director, FilmMaker, and Swivel 3D Pro.

Clearly, feature sets once limited to ultra highend animation systems are migrating to more affordable platforms in more affordable software packages. In researching this article, we counted no less than 300 animation packages (!), many of which it might be argued could be used to build characters. We limited our discussion here to programs optimized for designing characters.

Whether you want to add some character to your life or not, you can't help but see stunning examples of the art and craft of character animation if you watch TV or go to movies. The current state-of-the-art creations are so profoundly innovative, often times so magical and so seamlessly blended into so-called live action programming that more and more you'll be asking yourself — is it real or is it digital?

ROCK & ROLL MULTIMEDIA

How a Crack Team of Videographers, Reporters, Artists, Producers, a Musician, and Their Macintoshes Made THE WOODSTOCK '94 NEWS

BY GREG RULE

Whether it's exploring surreal CD-ROM worlds or holding onto lunch aboard a motion-based thrill ride, multimedia can be the next best thing to an actual out-of-body/mind experience. Delivering the hi-tech goods under extreme deadline pressures and budget constraints is another story. Just ask Liz Gebhardt, producer of *The Woodstock '94 News*. Her bust-butt team of technologists pulled off a multimedia miracle last August amid an 840-acre human mudbath known as Woodstock '94.

"*The Woodstock '94 News* was rock and roll multimedia," she smiles. "It wasn't, 'Okay, we're going to take nine months and do this cool interactive CD-ROM.' It was more about, 'We're gonna do it in nine hours!'"

And that's exactly what they did. Once in the morning and once at night, come rain or come mud, the Woodstock Jumbotrons lit up and the *'94 News* boomed to life. "Hey folks, this is Woodstock '94. We've got TV this time!" Hosted by an onscreen comedian who acted as an intelligent agent, and with the help of an animated hand/cursor, the newspaper-like broadcast swept viewers through daily performance schedules, backstage interviews, behind-the-scenes features, and comedic weather reports.

Mud, music, masses, and a paperless newspaper making its electronic center-stage debut on the Woodstock '94 giant-sized projection screens called Jumbotrons.

"We wanted to give the people at Woodstock information in an entertaining way," says Gebhardt. "We wanted to let them know about various activities on the grounds, give them tidbits about how Woodstock was put together, and also interviews with the artists. We wanted to approach it in a different way than MTV or CNN would."

The news crew set up shop inside the Apple Computer-sponsored tent, a key component of Woodstock's hi-tech tent city known as the Surreal Field. Gebhardt describes the surroundings: "The Surreal Field was a six- to eight-acre area integrated into the Woodstock site where visitors could experience CD-ROM titles, 3D movies, location-based rides such as Peter Gabriel's Mind Blender, interactive music, and various other forms of electronic art and entertainment."

Bringing Woodstock into the '90s was the overall goal of the news crew and their Surreal Field neighbors. "The event's organizers felt the Surreal Field would help define what the current generation was all about," Gebhardt tells us. "It really was a Woodstock for the '90s, Woodstock for a generation who had grown

up on video games and personal computers. A generation who was reading William Gibson, and getting up on the Internet."

For visitors of the Surreal Field, the hi-tech village was a welcome alternative to the music. For the people behind the scenes, it was an obstacle course of logistics. "Almost everything you saw in the Surreal Field needed electricity," says Gebhardt. "They probably trucked in every portable generator in the state of New York to power the thing." And when Mother Nature unleashed her liquid fury on the site, everyone held their breath. "We had to power down for a few hours when the thunderstorms rolled in on Saturday night," she reports. "We were working on a night paper, and the delay resulted in us completing the edition just as the runner had to take off for the main stage. We didn't even have time to make a backup copy."

With good luck and a leak-proof tent, the Apple news crew and its equipment survived the elements. With only a handful of hours to create and produce each installment, the team sweated bullets to meet their daily deadlines . . . which they did, heroically.

Watching the daily broadcasts was only half of the fun; Woodstockers were encouraged to observe and participate in the media-making process firsthand. "The Apple tent served as a production area for us," she explains, "but also it gave people a chance to come in and see the digital video and authoring process in action, and to actually help us create parts of the paper." Two segments — called "Question of the Day" and "Faces of Woodstock" — were created for that purpose.

Fig. 1. The "front page" of the *Woodstock '94 News* — an onscreen comedian and an animated hand guided viewers through the paper's various departments and columns.

For "Question," the crew set up a digital video camera station, and interviewed willing participants. "We asked people questions relating to entertainment, everyday life, and technology," Gebhardt reports. Selected excerpts were made into QuickTime movies, and incorporated into the daily broadcasts. For "Faces," the team used an Apple QuickTake 100 digital camera to capture still images of Woodstockers posed against a tie-die backdrop. The result was a colorful video montage of young, old, clean, and mud-caked attendees.

At the end of each short production cycle — and with their video, graphics, animation, and music all loaded into the Macintoshes, edited, and then sequenced with Director — the news staff transferred the final product to beta videotape, then hand-carried it to the Jumbotron operators for eventual broadcast on the big screens.

Fig. 2. *The Woodstock News* took viewers behind the scaffolding for one-on-one interviews with performers. Sorry, they didn't broadcast the backstage fight between Aerosmith and Metallica.

Putting It All Together

Rewind to Spring 1994. "The *Woodstock '94 News* was one of the ideas I pitched to Apple last March as a possible way to participate at Woodstock," says Gebhardt. "Originally we thought about doing a traditional newspaper or tabloid, but as time went by, we started to realize that paper wasn't the best idea. With at least 250,000 people coming to the show, one of the goals of Woodstock was to be as environmentally conscious as possible. If you're creating a lot of paper, you can image . . . just

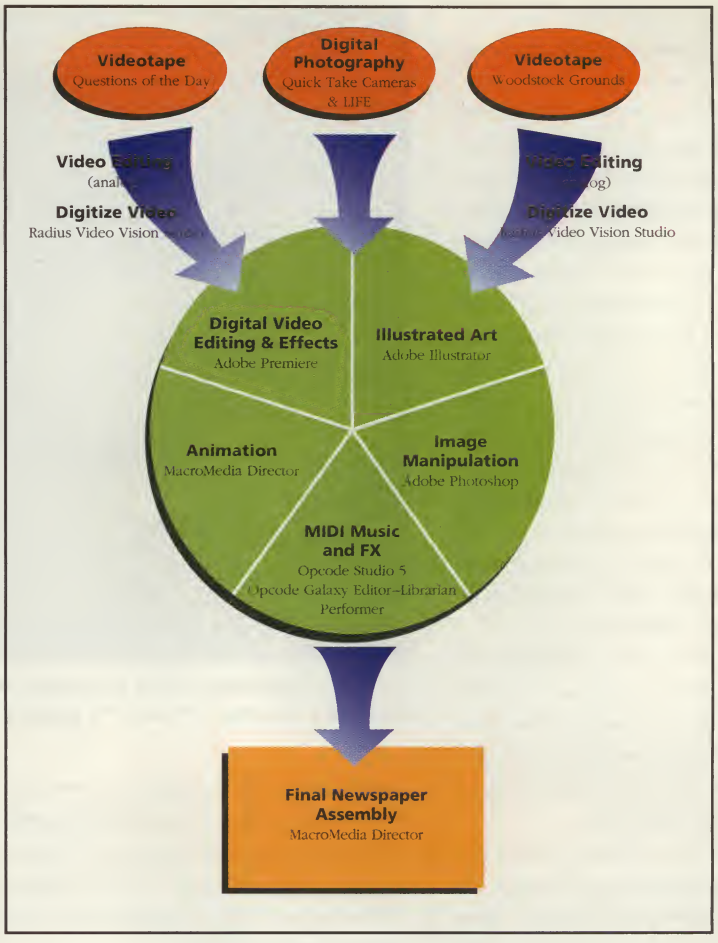
ROCK & ROLL MULTIMEDIA

one piece of paper to everybody twice a day would cause an incredible trash problem. So the idea of doing an electronic multimedia paper seemed more in line." Once access was granted to the Jumbotrons, the decision was made final: *The Woodstock '94 News* would be all-digital, which fit in perfectly with the hi-tech theme of the Surreal Field.

Pulling off a project of this complexity required a truckload of talent — and money. Objective number one was to secure sponsorship. "Apple has been a strong backer and leader of unique multimedia projects," says Gebhardt. "They took the chance a year ago in backing Future Zone at Peter Gabriel's first U.S. WOMAD [World Of Music And Dance] tour. As a unique cultural event that would expose people to multimedia and digital technology in a non-threatening environment, Woodstock was a natural."

Other companies who participated included Radius, Adobe, and MacroMedia. Exactly how much time, equipment, and money were they willing to fork over? "Let's just say we definitely brought things in for budget," reports Gebhardt. "A lot of people put in an incredible amount of their time and hard work — up to 20 hours days for the seven days that we were at Woodstock." The fact that Gebhardt made her budget was even more impressive considering no outside advertising dollars were brought in. "There were no commercials," she says, which most likely suited the audience of channel-surfers just fine. "The only thing that might even resemble advertising was the sponsors' logos at the end of each broadcast."

With a concept and sponsorship nailed down, and only a few weeks to make it all happen, Gebhardt started picking the players. "One of the key groups was Magnum Design from San Francisco [whose credits include the *Alice to Ocean* and *Big Anthony* CD-ROMs]. Magnum really was the core team, bringing together the Director element, because the newspa-



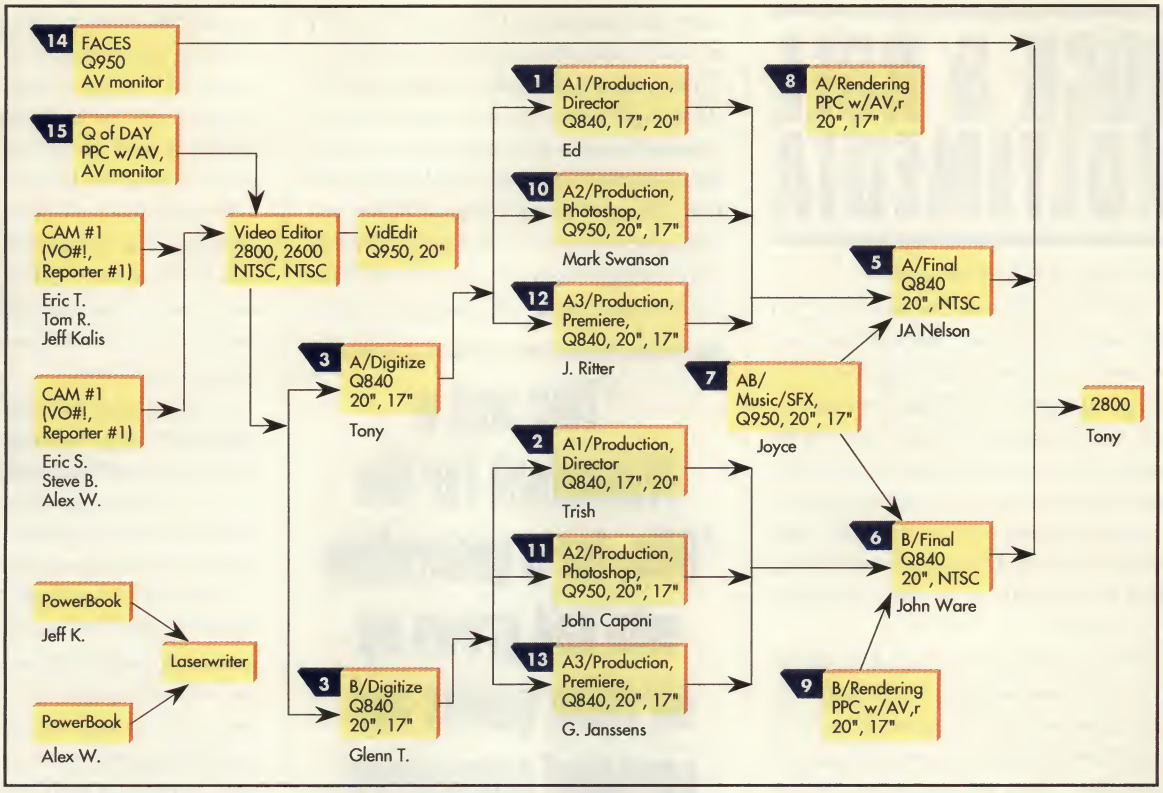
The production flow from the top down: the raw data, editing, adding media, and finally integration and broadcasting.

THE NUTS & BOLTS OF A DIGITAL NEWSPAPER

How much gear does it take to run a paperless newspaper? A lot. For *The Woodstock '94 News* over a dozen Macintosh-based workstations were trucked into the concert site. Components included ten Macintosh Quadra 840AVs, four Quadra 950s, and four 8100 PowerPCs. The 840AVs were outfitted with 80MB of RAM, and the 950s and 8100s with 48MB. The monitors were all Radius, either 17" or 20" color, with the addition of a few NTSC monitors for those doing video work. According to producer Liz Gebhardt, anyone running Adobe Premiere video had a VideoVision Studio system setup along with a two- to four-gigabyte Studio Array drive for handling the video.

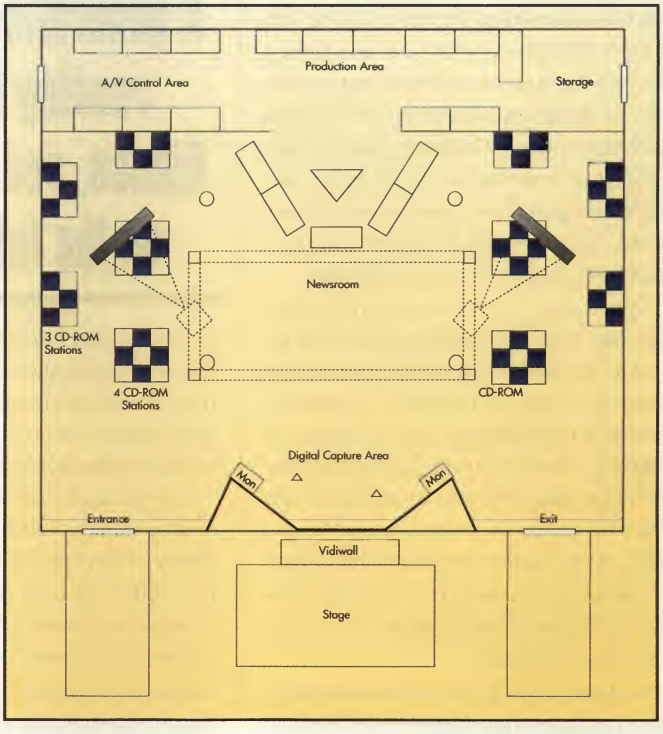
Five software packages formed the paper's backbone: MacroMedia's Director, Adobe's Premiere for editing digital video, and Illustrator, Dimension, and Photoshop for creating and manipulating still images. Roving reporters chronicled the event with camcorders, and eventually transferred their footage into the Macintoshes. "Some video was digitized using Radius VideoVision Studio," says Gebhardt, "other footage remained in its original beta-cam format." Meanwhile, staff designers cranked out a variety of graphics and animation using the aforementioned Adobe software products while musician Joyce Imbesi turned her electronic compositions into digital audio and MIDI files. With all of the material complete, each component was brought together and synchronized under the control of one Macintosh computer running MacroMedia's Director.

What'd it take to broadcast an electronic newspaper twice a day? A lot of savvy people working on a lot of Macintosh workstations amidst a lot of mud.



A view from the cockpit. Quadra 950s and monitors galore ran MacroMedia Director, Adobe's Premiere and Photoshop to crank out the electronic news twice a day.

Under the big top. Apple's Surreal Field tent offered visitors CD-ROM entertainment stations and a look at the news crew in action. A large video wall greeted Woodstockers as they entered.



per was done in a MacroMedia Director shell. They brought in some Director programmers and people to manage the digital video, the beta-cam footage, and the High 8 video-cam edits, and they worked with our artists on the overall design and interface." Radius also played a vital role in the video process by contributing, among other things, two beta-cam crews and a semi truck of video gear.

Eye-catching graphics were a must, along with a simple but elegant interface. Gebhardt enlisted the talents of Glen Janssens, John Ritter, and Jonathan Caponi — artists who gave the *Woodstock '94 News* its colorful face (see Figures 1 and 2). Rather than pen and ink, the designers used a combination of computer graphics and digital video images to create menus and backdrops for each of the paper's sections, including the psychedelic wash that accompanied the daily list of performers. "That was three layers of digital video," says Gebhardt. "Jonathan actually filmed his lava lamp and did some ink and oil projections," the footage of which was digitized and manipulated in Premiere — an interesting mixture of

ROCK & ROLL MULTIMEOIA

'60s icons and '90s technology.

Next on the list were the reporters. "Not really *writing* reporters," she explains, "but on-camera reporters whose mission it was to go out and get stories." That team consisted of Alex Williams, Jeff Kaliss, Tom Rielly, and Steve Burrows. With camcorders in hand, the news crews scoured the concert grounds for interesting and relevant material. They filmed everything, from action in the mosh pits to the campsites to the artists backstage to you name it.

For the finishing touches, L.A. musician Joyce Imbesi was brought in to serve as the paper's onsite composer. Stationed behind a rig that included a Mac Quadra 950, a Roland S-760 sampler, a Korg M1 synthesizer, Mark of the Unicorn's Performer sequencing software, Opcode's Galaxy editor/librarian software, and an Opcode Studio 5 MIDI interface, Imbesi churned electronic soundtracks on the spot. "She was doing original scoring to DAT [digital audio tape]," reports Gebhardt, "as well as taking MIDI-generated tracks directly from a submixer into another computer to be digitized, edited, and eventually flown into Director." Mark Swanson handled the audio edits.

With the cast assembled and in place, and with some preliminary graphics, video, and animation complete, Gebhardt and her entourage packed their bags and flew East. "The advance team from our logistics company, Witlin and Waigand, arrived on Sunday just to make sure the trailers and tents were up and okay," she says. "The newspaper team came in Monday night, and all day Tuesday we set up the gear. By Wednesday we were out shooting." The Woodstock gates officially opened to the public at noon on Thursday.

So how well did the news-making machine run once it was plugged in and powered up? "In terms of technology," she tells us, "the biggest problems we had were mostly with the beta-cam editing decks. We kept getting drop-outs, which we thought was a result of dust and dirt in the heads, or possibly the result of unstable power. With all those generators, god only knew if the power was dirty or not." As for the computers themselves, "There were very few problems with the Macs. We thought a few machines might have had a virus or two, but other than that, everything went fairly well, especially considering the fact that when we tore down some of the machines, we found mud on the cards." The software packages used most extensively in the process were Adobe's Photoshop, Premiere, Illustrator, and Dimension, and MacroMedia's Director. Key hardware elements were Macintosh computers outfitted with Radius VideoVision Studio cards and StudioArray storage systems (see sidebar, page 32).

"This was a Woodstock for the '90s, for a generation who had grown up on video games and personal computers. A generation who was reading William Gibson, and getting up on the Internet."

According to Gebhardt, "The greatest difficulties we faced had nothing to do with technology — they had to do with getting our press credentials, moving our cameras through crowds of people camping in every conceivable place including creek beds, and having to take cold showers every morning in our trailers. This was not like hanging out at MacWorld in an air-conditioned room or hotel. This was living in trailers, four people per trailer, usually with 20 gallons of water a day for the entire group."

Gauging the success of a project isn't always easy to do. "In this case," says Gebhardt, "the proof of whether it was truly successful was how the audience reacted to it, as well as how happy the corporate sponsors were with the project." Satjiv S. Chahil, vice president of Apple's New Media division, reports, "It definitely captured the spirit of the event, giving participants all the information they needed to get the best out of Woodstock. A newspaper of this type wasn't even possible at the original Woodstock in 1969. Today, the audience expects special effects, on-the-spot news, personality features, and more. I don't think we disappointed them."

In retrospect, would Gebhardt do anything differently? "Well, you always want more time. What else is new? The way it worked out, there were 14 weeks to sell the concept and five weeks for pre-production. I wish it had been the other way around. No one likes to work 20-hour days," she laughs. "Other than that, I think I might have chosen to do less, and do smaller segments interspersed throughout the day. We took on a pretty ambitious project in terms of the number of stories — eight or nine sections in every paper, and that's a lot of material to produce each day. A lot of bits and bytes to push around.

"Guerrilla multimedia," she continues, "that's what creating *The Woodstock '94 News* was all about. Sometimes it's almost more about how well your team will coalesce and how they will deal with the elements and difficult situations — mud, crowds, thunderstorms, close-quarter housing — than if the technology will work. Rock and roll festivals are great places to test the boundaries of multimedia, both from a technical as well as a creative sense. From a creative perspective, you have to create something that will really grab and maintain people's attention — from the front row to the guy standing half a mile from the stage watching the Jumbotrons. And technically, you never know what you might face in terms of the elements causing problems with your equipment — dust in the video deck heads, thunderstorms during which you have to power down, rain coming in through AC vents — and there is no local Apple dealer around when you are out in the middle of what is essentially an 840-acre cow pasture."

Greg Rule is an assistant editor with GPI's Keyboard *and* Best of Guitar Player *magazines. He wasn't at Woodstock, but he experienced it vicariously by covering his living room floor with mud and ordering Pay-Per-View.*

SEARCHING FOR INTERACTIVE FICTION

Continued from page 19

and clueless on a bizarre, isolated island, and must discover what you can on your own. In *Grandmother and Me* you are a young anthropomorphized furry animal in the care of your doting Grandmother, and everything in the world wants to buzz or moo or go clink or fly away or otherwise announce itself to you in some slightly unexpected fashion . . . if you ask to see it, that is.

And therein lies their binding similarity. They invite you to explore not to solve a puzzle or win a prize, but just for the sheer fun (kid version) and intense focus (adult version) of trying to figure out how the world works and what your place in it is.

These two are still not stories, or only barely so — but the way I felt, experiencing them, is the same way I feel when I write my own fiction. All writers will tell you that they know the work is going well when things happen which they did not expect; when characters turn to face their creator and say things the creator didn't know they knew. Seeing a world in your head like that is the first step in storytelling, followed by editing it down, removing the boring bits, and arranging what remains for effect. Interactive Fictions like *Myst* and *Grandmother and Me*, by introducing people to that feeling, offer them a chance to shift one vertex on the triangle and trade the passive role of audience member for the active role of artist.

When I got done with the deep immersion, I noticed that when the disk caddy popped out of the CD-ROM drive, it was warm. That's appropriate, because right now the level of artistic development in I.F. is still lukewarm.

There's hope, though. What we need . . .

What we need is D. W. Griffith. Or someone like him. The movies were just filmed plays before he came along, a 32-year-old actor and playwright who fell into writing "scenarios" for one-reel films as a way of making a steady $5 a day. But when he became a director his true talent showed itself. If Dickson had understood film's commercial possibilities, it was D. W. Griffith who understood the medium's terrific power for art. In a single five year period he churned out over 400 films for the Biograph Company, along the way inventing the close-up, the scenic long shot, cross-cutting, fade outs and fade ins, non-rectangular image masks, and more. He even pointed the way to a new kind of acting that was purely for film, by finding and developing talents like Lilian Gish, Mary Pickford, Mack Sennett, and Lionel Barrymore.

Other people invented motion pictures. But it was D.W. Griffith who gave the new medium its own language.

Interactive Fiction is still caught up in the left-over tangles of its crazy parentage. It doesn't have its own language yet. But if it does have the potential to be a true artform instead of a mixed-up wannabe, then somewhere out there, still unknown, is the artist who will point the way — the D. W. Griffith of bits and bytes and digital sound files and compressed video.

Whoever sees first sign, give a yell. We're waiting.

Brother can you spare a page? Robyn Miller as brother Sirrus.

CASE STUDY

THE MAKING OF MYST

AN INTERVIEW WITH ROBYN MILLER

It starts out innocently enough. A 3D logo spins its way into the foreground. Click. A night sky fractures, disgorging a book. It tumbles in slow motion, down down down. As credits roll past a deep voice speaks of books and endings that haven't been written yet. Synthesized triplets paint a dark and forbidding sonic atmosphere. Lightning bursts as the tome crashes to the ground. Click. ■ The book, up close and personal, opens to reveal an animation of a flyby over an otherworldly landscape. Banking. Turning. Stop. Silence but for the wailing wind. Point and click. Image fades to black. Soundtrack swells. The screen fills. Another sonic icon — yeeoww. You're in the picture, standing on a dock. In the distance is a hill of some sort. The only sound is of waves breaking against the dock. You know that wherever you are, you're alone. ■ This is not a game you want

BY DOMINIC MILANO

INTERVIEWS BY JIM AIKIN & DOMINIC MILANO

THE MAKING OF MYST

to play by yourself at one o'clock in the morning.

This is *Myst.* It's unlike any computer game you've ever played. There's no shooting. No dying. No scoring points. No need for the reflexes of a 12-year old. Instead, there's mystery. Fear. Drama. Excitement. Discovery. Wonder. And puzzles. Oh, are there puzzles. And as you solve them, something remarkable develops — plot.

All this from a game that has a user interface so simple it'd be embarrassing if it weren't so brilliant. There are none of the familiar paradigms of electronic role-playing games. No inventories of stuff you pick up. No type-in dialog boxes to interact with characters you encounter along your way. No multiple choice actions or control panels to intrude on the illusion.

The many treehouses in Channelwood were based on two models, only their interiors were customized. The trees, also, were derived from a single tree model that was reduced and enlarged to create the illusion of a vast forest.

There's just you and a new world to explore. For tools, you get your eyes and ears, your wits, and a mouse to go up, down, left, right. Sometimes you get to grab something. Every now and then, you can pick something up. But that's it.

Doesn't sound like the huge leap in interactive fiction design that everyone's talking about, does it? But that's the beauty of *Myst.* The complexity is right where it belongs — in the environments.

One of the more remarkable aspects of *Myst* is that it seemingly came out of nowhere. It wasn't produced by an industry giant. It was the brainchild of two brothers, Robyn and Rand Miller. Rand is a computer programmer. Robyn an artist and musician. Once upon a time, Rand talked Robyn into dropping out of the University of Washington to form Cyan to produce computer games for kids. Their first products — *the Manhole, Cosmic Osmo,* and *Spelunx and the Caves of Mr. Seudo* — received wide industry acclaim. And more importantly, taught the Millers some valuable lessons about interface design.

Myst was the project they'd dreamed of for years. Their first stab at designing a goal-oriented game for a "slightly older crowd." That is, a game for people their own age — Robyn's 27, Rand 35.

The Millers' inspiration came from *Mysterious Island,* the Jules Verne classic about a group of Civil War soldiers who land on an island full of monsters and machines unlike anything they've ever seen before. Robyn had been reading the novel, and the game might have been called *Mysterious Island* but for his suggestion made jokingly that they shorten the name to Mist with a 'y.'

The story — the Ages of Myst (Myst Island, the Selenitic Age, the Mechanical Age, the Stoneship Age, Channelwood, and Dunny) — took two months to work out. Building the game took two years. The entire project was funded by Sunsoft of Japan, who own the rights for all but Mac and PC platforms. Those are controlled by Broderbund. Cyan's development team worked on the Mac version. Broderbund handled the port to the PC.

We caught up with 3D modeller/musician Robyn Miller as the development work on *Myst 2* was just getting underway. We found him open and willing to share his how-to experiences, unpretentious, articulate — a far cry from his persona as Sirrus, brother of Achenar, son of Atrus, the guy stuck in a book that's stuck in a library that's stuck on a deserted island called *Myst.* . . .

• • • •

What was the biggest challenge you faced doing *Myst*?

As I look back over the process, for me in particular it was creating the pictures. However, if I had it to do again, I might change my mind, just because of what we're experiencing now with *Myst 2.* We're doing that design right now. And it's quite a challenge, because it's not the kind of thing where we're all sitting around throwing out ideas that just start to develop into more ideas. It's more that we're all sitting around racking our brains for ideas. I think I forget how difficult that was on *Myst.* It's not like ideas come every few seconds. It's like, sit around for 20 minutes throwing out one dumb idea after another. At the end of that you might have one good idea.

The images were all 3D-modeled?

Almost everything. What wasn't was done with photography.

Interesting. I had the impression that some things, particularly the water in the Stoneship Age, might have been photographs.

Oh. Let me make myself clear. Everything you see like that was not photography. When I say photography, I mean people talking in the books. You know, the movies. Everything else was done with modeling. There were no rooms that were built and then photographed. They were all modeled using StrataVision 3D running on the Macintosh. We chose that software because of its rendering quality.

So things were developed as wireframes initially, and you'd map textures to them later.

Yeah, we'd do one room or one exterior at a time. So I'd build an object, say a desk, find a nice surface texture for that desk . . . I mean, finding that texture could mean drawing it, but more likely it would mean going out and photographing it. Then I would sample that texture by scanning the photograph into the computer, then wrap the texture around the object. I think that's what makes the scenes so realistic in *Myst.*

The bark on the wood in the Channelwood Age or the cracking cement somewhere else were actually photographs of those things. We also created other types of maps besides

Robyn (L) and Rand, the Brothers Miller, on Myst Island — the virtual world they built with a little help from the rest of their gang at Cyan: Chris Brandcamp (sound effects and business management), Bonnie McDowall (testing), John Briggs (data management), Josh Staub (3D artist), and Richard Watson (programmer).

picture maps. We made things like bump maps, which give the illusion of a surface rising up and down.

So, for example, wood isn't perfectly flat when it's part of an old chair or just a plank lying on the ground. There are all sorts of nooks and crannies. The dark parts of a bump map would represent the depressions and the lighter areas would represent the parts that are rising up. So we'd wrap the picture around an object, then we'd put the black and white bump map on. That way you'd end up with something that looked pretty realistic.

So the texture appears three-dimensional . . .

Yes. Textures are frankly . . . There are two things in our modeling and rendering that we concentrated on more than anything. It wasn't the modeling, though I think a lot of people would think it would be. There's only so much you can do with modeling. What makes things really look detailed is textures, intricate textures, and very moody lighting.

How much fine-tuning did you do with the light sources?

It might sound like a lot, but there could be as many as 30 light sources in a room. There's a lot of light you the user don't actually see the source of, but that we put into that room to light up little areas like corners. So you would have maybe three main light sources that were obvious, but then we'd put in all kinds of other sources that you don't see. You just see what it shines on — highlights here and there to make things more subtle.

One trap a lot of people fall into doing modeling and rendering is they put in a couple of lights that are bright enough to light up everything. It looks like fluorescent lights have lit the room, which is not a nice look.

When you're building, say, an interior. Do you do it as a whole, or do you put together the walls as separate files and combine them later after you've decided on camera angles?

No, we create the room just like we'd be building a set for a movie or something. We wireframe the entire room, every single wall, every single table, chair, bed, and pillar. When that's finished we start setting our cameras up and taking pictures. When I say finished with a room, I mean finished with the modeling, finished with the textures, and finished with the lighting. Then we start taking those shots.

The computer does all that work, you know, calculating shadows and refractions and reflections. Shadows are another thing that we didn't miss. You don't see them in a lot of other programs, at least not yet. But there are shadows everywhere in *Myst*. It takes longer for the computer to calculate those shadows than if we hadn't included them.

Do they end up being soft-edged based on the width of the light source?

One of the many clues to working through the myriad puzzles of *Myst*, this ariel map includes functions (solid color lines) created with HyperCard XCMDs.

THE MAKING OF MYST

A toy bird from the Mechanical Age. One of the many scenes in *Myst* that incorporate QuickTime movies whose boundaries are well masked — when you click on the crank it winds up the bird, which flaps its wings and turns it head.

You're getting into some complex stuff here. They did not in *Myst*. They're always hard-edged in *Myst*. That was because of the limitations of our softtware. Other programs allow you to make soft-edged shadows now, simulating wide light sources. But at the time, no, all we could do were hard-edged shadows.

There are over 2,500 images in *Myst*. Were there more that you rejected?

Oh yes. As a matter of fact, it's hard when you're working with computer rendering and modeling, because you set up the lights and have no idea how they look when you're working with the wireframe. So, what you have to do is base a lot of it on experience. You know, "Okay, I think when I set up this lighting, it's going to look the way I want it to," because you have that in your mind. But you don't really know what it looks like until you render a shot, a test shot. So a large part of what we do is make quick test shots that maybe don't have all the reflectivity turned on or that don't have refraction turned on, but that will still give you a chance to see what the lighting looks like. There were a lot of shots we didn't use. Shots you thought for sure were going to work, but on coming back the next morning, you'd find five that were worthless because you forgot to light an object right in the middle of the room that happened to be pretty important.

So you did your rendering overnight? How long did it take to render one of those images?

Images took anywhere from two hours to 48 hours. The average was eight hours.

How long did it take to design rooms?

That's a good question. I remember some of the times, for example to design Siruss' room in the Stoneship Age — the real fancy one with the bed in the center of the room — that took two weeks to design and build that.

Working how many hours a day?

A lot of hours a day. I don't know. Maybe 12 hours a day.

That was designing and modeling, not just drawing and planning?

That was everything. But there were some other times when things would take longer. You do a design and it wouldn't work well and you'd go on to something else. Change it a bit; do it over again. So Sirrus' room in the Stoneship Age was a successful design from beginning to end without any hitches. There were other times when a room would take three weeks. The outside stuff was the hardest, because the models got really really big. The Channelwood Age was all one model. The rooms in the tree houses were their own individual models, so things were moving faster — we could move around more quickly.

But outside of those treehouses, were we had the whole forest, the pathways, the pipes, and the buildings, things moved very slowly. That whole area took about two months. And that doesn't include indoor shots of Sirrus' and Achenar's rooms.

That area is one of our favorites.

That was the last age we did. It kind of progressed. We learned a lot as we got further and further into things.

That brings up a fascinating question. What order did you design things in? The *Making of Myst* QuickTime movie shows that you started by figuring out how to render the geography using a 2D grey-scale image and using extrusion to generate

Two examples of making the world seem larger than it is. On the left, a QuickTime movie of a windmill spinning in the distance is viewed through a window, which masks the movie's limited size. On the right, Sirrus (a.k.a. Robyn Miller) delivers a message in this ashtray-turned-Buck Rodgers view screen, again taking your mind off the limited size of the QuickTime movie and creating a larger virtual reality. Note the bump-mapped 3D woven wood textures.

the hills and valleys of *Myst Island.*

The very first island we started with was Myst Island. After that it was the Selenitic Age, then Stoneship, Mechanical, and finally Channelwood.

It's interesting that you built a whole age around sound.

Well, one of our ideas when we first started out was we wanted to make the game very much based around your senses. So when the player played, they had to rely on their real senses. Their hearing and sight. Obviously we couldn't do touch or smell, which was a great disappointment [*laughs*]. You know, people can hear. Why not actually use that for clues in a game? That's why we did so much centered around hearing.

You know you hear something in the midst of other things and think, "Oh, was that a clue?" Our experience with text-based games of the past has been messages that say, "You see something out of the corner of your eye . . . " That's not how you see something out of the corner of your eye. You actually *see something out of the corner of your eye!* Or maybe you don't see it. It depends on how well you're paying attention. So we just made it based on how well people were paying attention.

The credits say that you used six Macintosh Quadras. Were they networked for rendering or set up individually?

Individually, because when we networked them, we were getting slower rendering times. What happened is that it would take that much more time going over the Ethernet. It was faster to set up a queue of renderings on each Quadra and let one Quadra render an individual scene. So while I was modeling on one, the others were set to render. And that was toward the end. Early on I had a Quadra I was working on, and the other artist, Chuck, had a Quadra he worked on.

How were the Quadras configured?

When we first got those machines, *whoa*, were they hot! I look back on them now and they were just pieces of junk. When we first got them, they'd just come out — remember this was two and a half, three years ago. We got, like, 700s and 900s, with 20 or 24 megabytes of RAM in each one. Oooh. And we quickly ran out of memory.

So we designed all of Myst island and Selenitic Age on machines with 24MB of RAM.

Were you working in 8- or 24-bit color?

We designed it all in 24 bits and later compressed it to 8 using custom palettes and QuickTime compression.

Anyway, we real quickly upgraded to 64MB. And even found limitations there towards the end. Especially toward Channelwood, where the models were so big. But the biggest limitaton was not the speed at which we rendered, because we could buy more Quadras so we could render that much faster. The real problem was the speed at which we could actually move the wireframes around on screen.

In Channelwood, we would actually wait for a wireframe redraw that would take seven minutes, there were just so many polygons. It was horrible. That's why it took so long to do that age. We would read magazines while it was redrawing wireframes.

That's probably one of the big reasons we've gone to SGI machines to do *Myst 2*.

Will they give you realtime on everything?

Well, it is realtime on smaller objects, but you start getting up there into millions of polygons and it starts slowing down. Still, they're unquestionablely much, much, much, much faster.

The Clock Tower puzzle, which Robyn Miller describes as, "A little weak. . . because there should be a reason for a puzzle's existence within the story. . . Anyone who was actually on the island could have just swam through the water. . . ."

Which SGI machines are you using now and what software are you running?

We decided that there was no point getting Indys. We would have much rather gone to PowerPCs. They seem to have a much better upgrade path. Indys don't have the 3D geometry engines, so we went with Indigo 2 Extremes running SoftImage Creative Environment.

Were there compromises you were forced to make by the limitations of the Mac technologies you used to do *Myst*?

Oh, absolutely. As a matter of fact, that's one of the things in the design you have to constantly keep in mind. How can we do this with the technology we have? We've even had to deal with limitations designing *Myst 2*. We thought we'd put a flowing stream that trickles over some rocks right here through this landscape. And we said, "Wait a second, this is not a good idea, because we don't have the technology to make a little flowing stream that trickles over the rocks look like a real flowing stream from however many different views." I mean, you're going to be seeing it from 20, 30, 40 different views. So we decided to make it into something else.

In Channelwood, for example, we originally designed all the pipes — there are pipes that run through the entire area, water flows through those pipes, and they power things — those were originally open channels. Hence the name Channelwood. Late in the design process, we decided to enclose those because of the technology.

So you used the sound of water trickling as a cue instead.

Exactly.

It's much more subtle.

That's what we decided too. It was better because you weren't constantly aware of the fact that there was this water traveling right beside you. It kind of made you forget that and almost made it a little more difficult to figure out the puzzle.

The difficultly of the puzzles is obviously something you guys devoted a lot of thought to.

Boy, it is.

What makes a good puzzle?

There aren't very many of them. A good puzzle has to make sense with the story. In other words, there's a whole background and story going along while you're playing a game, and the

puzzle has to somehow fit into that. It can't be just some completely obscure thing that has nothing to do with the story. There should be a reason for that puzzle's existence. In *Myst*, there were reasons for those puzzles' existence. Now, in some of the puzzles we had to stretch. And maybe that wasn't good.

Mood lighting and incredible attention to detail make exploring *Myst* a compelling visual experience.

Maybe it was okay, since *Myst* was the first game we had ever done like this. But, a good puzzle is a puzzle that makes absolute sense in the story. It's easy for a player to figure out, but not too easy. It's hard for a player to figure out, but not too hard. There's a real balance of all these things.

What would you consider a puzzle that was a stretch in *Myst*?

Okay, there's all kinds of them. Here's a puzzle that's a stretch. Down on the end of Myst Island, there's some gears that rise up out of the water and lead you to kind of a clock tower. The clock tower encloses yet another puzzle. It doesn't matter what that is, it encloses something you need to continue on in the game. And that thing you need was hidden for a reason. But in reality, anybody who was actually on that island could have just swam through the water and gotten to that clock tower. So that part of the puzzle is a little weak. It doesn't really fit with the reality or the story.

It's an artificial barrier. Also, if you'd really been standing there turning the wheels, you wouldn't need to click the mouse to look up to see the clock . . .

That's another example.

What puzzle are you proudest of in the game? What do you think really worked?

The puzzles I'm proud of — There're a few of them that I'm really proud of. One of them is raising the ship. There are some logical leaps in that puzzle, but still it's so neat because you get so many different pieces of the puzzle scattered in so many different areas. And you're taking all those in and not knowing how they connect to each other or even that they connect to each other.

Another one is everything in Channelwood Age. It is really neat because it's got a realism to it. They really would have built a windmill up there to pump the water up and into the channels to power those little machines at the end of them. I mean, it's realistic.

Your user interface is extremely effective. There are so many computer games where you have an inventory of dozens of objects, you can drag things around on screen, you can type in dialog. But *Myst* is simple point-and-click. Was that intentional?

Absolutely. That's been a very common factor in our games since we did our very first children's product, *The Manhole*. Maybe it comes from the fact that we were doing things for children that had to be simple. They had to be stripped down and familiar to children. They had to be something that children could map to the real world, something they were familiar with so they could easily use it. And what children know is the real world. They know how to work the real world. They know how to get from here to there. They know when they see a place, to go forward, they just go forward. There isn't a button in the real world that says, "Go forward." There isn't a button when they meet their mom that says, "Talk to my mom now and choose any one of these three responses." The real world is the best user interface there is. And it's an invisible interface. Or at least it's something we've all learned.

So we tried to make something that was as close to the real world as possible, and that meant the absence of any kind of computer interface, like buttons and things like that.

Perhaps part of the reason it's so effective is that the interactivity is not with the computer, it's with the environment of the world of *Myst*.

Exactly. Our feeling was if a player feels like he or she's playing a computer game, then we've lost something. They've lost that illusion that they're lost in this world. I mean we pulled them back out of the world and we've placed them in front of a computer.

What software did you use to as your authoring system?

We used Hypercard. But it wasn't just Hypercard. We used it as a shell in which we embedded a lot of other little programs that allowed us to do everything we needed to do.

Such as?

The main, obvious one, was display of color. Hypercard 2.2 I think does display color, but it's not real fast. When we did *Myst* we weren't using 2.2, so there was nothing to display color. We needed something to display color very, very quickly. So we got a guy to write X-commands (XCMDs) to not only display color but to turn off some of the things in Hypercard that we didn't need. Like the black-and-white bitmap display. That whole part of it was taken away. We didn't need the screen buffer in there and it really sped up the color for us.

Other things were small. Obviously we used some QuickTime XCMDs, some color button XCMDs that we had written for specific points in the game. Like in the map of Myst Island, there's a red line that turns around. That's an XCMD. And things like that where we needed the extra speed.

How did you pull off the multiple-view QuickTime movies?

Explain to me what you mean.

Okay, when you get to Dunny and see Atrus sitting at the desk, writing, and you move around the room, your view of Atrus changes with the angle you're viewing him at.

[*Laughs.*] That's real simple. It's not multiple-view Quick-

Time movies. It's just a bunch of QuickTime movies taken from different views of Atrus. You'll notice that when you first swing to a different view, Atrus is still. That's because we took the first frame of the QuickTime movie and pasted it over the image. So the person is still, then boom, starts moving as soon as the QuickTime movie loads up. Simple!

Simple but not obvious. Another one of those things is where you're riding the underground train in the Selenitic Age viewing these QuickTime movies of the track ahead through a tiny porthole. That was done on purpose to accommodate a small movie wasn't it?

This is a very import aspect of our design. We realized we couldn't have a lot of large movies, but movies seem a lot bigger if they're part of a larger picture. We couldn't have a whole view moving through those tunnels. We didn't have the technology. We might be able to do it a lot more easily now. Back then we couldn't. We just made it a window, so you feel like it's all real because you can't see the border around that window. Or anything that moves in an environment. For example, the windmill in Channelwood. It's the same exact thing. You're looking off at this picture and you see something moving in the distance and you just have the feeling that the world is alive. That everything is moving. It's a good technique to just give a feeling that there's more there than there is.

You also did a nice job of blending the edges of other movies that aren't framed by windows, for example the cranks that wind up the bird and the jack-in-the-box in the Mechanical Age.

Oh yeah. I'll tell you what we did. On a lot of those, we took the very first frame of the QuickTime movie and pasted it in. The QuickTime movie would be dithered on the fly — they're in 16-bit, but if you play it in 8-bit, it dithers the stuff on the fly. We take that dithered first frame and paste it with feathered edges into the pict. And that would give a much better transition when that movie popped on the screen. There are some places we didn't do that, but others we did. Especially with Atrus at the end. It would have really broken the spell if you'd seen that movie pop up there. It might have seemed a little too fake.

A scene from the Selenetic Age — the first age developed after designing Myst Island. Note the lighting and 3D texture on the walls, created with bump maps.

How did you do the video noise in the books?

Nobody's ever asked me that. That was easy. I took a video camera and got a bunch of noise on the TV. I put in a tape with noise on it, then videoed the screen with noise on it, while I zoomed in and out. Zooming in, you get bigger lines. Then zoom out and get some variety in there. Also, rewinding and fast-forwarding the tape would cause bigger lines to pass through. You know, just to add some variety. And I used that as a background. I changed colors and hues depending on which brother it was and put it right behind the masked brother. We did all the video editing in Premiere.

How about the modeled trees. Was there a generic tree that you cut and pasted here and there?

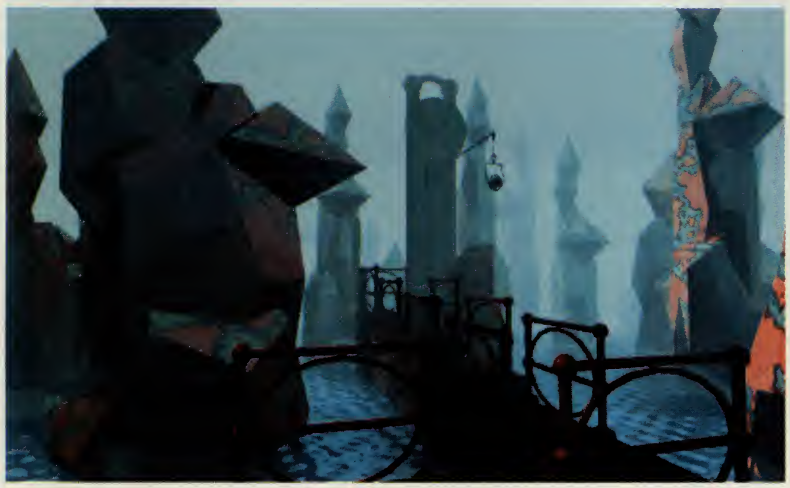
The trees, and it doesn't matter what Age you're in, all of the trees are just one tree per Age. We took that one tree and made instances of it all over the place. We shrunk them and made them larger and smaller and squat and all different sizes and rotated them. But it's all the same tree.

What about the tree houses in Channelwood? They seemed very similar to one another and at times it seemed that part of the puzzle was figuring out where you were.

As you explore this room in Dunny, you come apon Atrus, who's busy writing. Walk around the room and look back (R) and you get a different view of the same QuickTime scene. "You'll notice," Robyn Miller points out, "that when you first swing to a different view, Atrus is still, then boom, starts moving as soon as the QuickTime movie loads up." Again, notice the three-dimensional textures on the walls and the mood created by the lighting and the shadows it casts.

THE MAKING OF MYST

Yeah. The reason for that was another technical limitation. If it's all the same geometry, it renders a lot more quickly. So if you create one tree rather than 150 different trees, if it's the same geometry, it's going to render a lot more quickly. So we just created, I think, two huts, so all the computer has to load into memory is those two huts.



The Selenetic Age is designed around sound. "We wanted to make the game very much based around your senses," explains Robyn-Miller. "Our experience with text-based games has been messages that say, 'You see something out of the corner of your eye.' That's not how you see something out of the corner of your eye. You actually *see something out of the corner of your eye!*"

In the credits, there's mention of MacroModel. What was it used for?

We didn't use it much. I mean, I did one model with it. Chuck Carter did two or three. We just didn't use it that much. At the time it was the only thing we could do some stuff with. I did a mask in Channelwood with it, but 99.9% of the modeling was done with Strata.

Do you think you're going to be stretching the capabilities of the Indigos the way you did the Mac systems?

I don't think we were stretching the bounds of Strata. I just think we were using it for what it was meant for, although it's surprising to me that a lot of other people haven't. And I see some cool stuff done with SoftImage, but in the short time I've played with it, I'm surprised I don't see stuff that looks more realistic. When there's so much power. Sheesh. We can build jungles now with all different trees and all kinds of stuff.

I know one thing that's going to happen is that we're going to push these like we pushed Strata and we're going to end up with slow redraws again.

Let's talk about the musical score. From the movie, it looks as if it was all done on an E-mu Proteus MPS and Master Tracks Pro running on a Mac.

That's all we used. I have to admit that I love music. Music and art were my love as a kid. In high school I kind of switched back and forth between music and art. The only reason art became my thing was because this whole thing came up. It was out of necessity.

Wait a minute. You were thrust into all this modeling stuff as a matter of necessity?

Not so much. I had always been fascinated with that stuff. Since I was a kid and I had seen it, a little place here and a little place there. I painted when I was a kid. But modeling was always too highend. I would never be able to do that stuff. So when the opportunity arose . . . when the first program came out that I was able to actually use, I freaked. I couldn't believe I was able to do 3D modeling. It was a dream come true.

What was the program?

That was StrataVision. That was years ago. We bought it long before we did *Myst*. We were still doing hand drawings for the other games, but we practiced Strata and used it because it was so much fun. So it wasn't so much necessity as it was a dream.

Okay, let's get back to your music.

Music is still just as big a love for me. That's why it was so much fun to be able to do the music for *Myst*. I finally got to express myself in a more serious way.

What other kinds of things have you done musically? Did you play in bands as a kid?

I didn't play in bands. I was the kind of kid who bought synthesizers and guitars and wrote songs. I was never really interested in playing in bands. I was a lot more interested in buying music theory books.

It's interesting that you wrote songs, because the music for *Myst* is anything but songlike. It's more like a film score — a studied film score.

That was a big fear, because I didn't know if I could write that kind of music. I've enjoyed listening to that kind of music, but I'd never *written* that kind of music. We had some problems in the beginning. I wrote all that music in two weeks . . . at night! During the day I was doing my art. A lot of that time was writing a song and playing it for everybody and whoa, does it fit? It's too melancholy. It's too depressing. It sounds like a death march. And so a lot of the stuff was failure at first. But it worked out well.

But it's different from movie scoring too, because in a movie, you can manipulate the person's emotions so well. Whereas, in this kind of environment, the person does what he or she wants to do. And if you start manipulating their emotions with the music too much, if you interfere with that too much, it makes it become more linear. You want something that no matter what they do, the music changes. If they walk out, the music stops behind them. And they don't really notice it that much. The music doesn't come on with a bang. It's just kind of there and creates a mood, but not an overwhelming mood. That's something I've heard on a lot of CD-ROMs. The songs are so prominent and the melodies are so overwhelming that they take away from the non-linear feel of these computer games.

How much attention were you able to pay to your choice of gear you used for the score?

When it came to doing this project, frankly, I just didn't know what was out there, equipment-wise. And I still don't, because it's not something that I have time to do a lot of research on. But sheesh, it seemed to me I had a ton of power with that software, which was the software we had laying around, and that keyboard with all the sounds it had in it. And they were all customizable. There was a lot of power there. It would be nice to have a studio. Maybe for *Myst 2* we'll end up getting some more, but you can do a lot with just a little bit.

When you scored *Myst*, did you run everything out of the MPS direct from the synthesizer to a master tape or did you

do multitrack recording with different effects and stuff then mix it down?

No, it all came out of the Proteus at once. It was an utter joy for me to be able to do that. I've done music for some other projects in the past. But this was music that I really enjoyed. It was more my style.

It does add a ton of atmostphere. Does it bother you to have the audio so grainy from the compression?

It doesn't bother me, because I wanted the game to be fast. However, it does bother me that I'm the only one who's really ever sat and listened to the music, because there was a lot more that I did with that music that no one will ever hear unless we decide to sell it as a CD or something. It was recorded in 16 bits, but compressed down to 8. I think it went from 44.1kHz to 11kHz. There may even be some 7kHz stuff too. It was sad because so many of the instruments fell out. Like in the opening scene, there's a hi-hat track. It was part of the drum track that was completely lost. It will be nice when the technology is at a place where people will actually have stereos hooked up to their computers or their entertainment devices, whatever they may be, and we can do high-quality music.

There's something like 40 minutes of music in the game. Was it consciously composed for segments to loop for as long as a player was in a certain area?

Oh, yeah. But that's not that difficult. I mean, we didn't compose it so it would loop seamlessly and you would never hear the loop. I think all the music ends and then goes into the next part, but the music doesn't have big rum-pum-pum recognizable parts that stand out. You know, where you think, "Oh I've heard that before."

It just kind of flows along. Were there any sections where the music was mixed with the sound effects tracks? Were they ever both going at once?

Yes. But in the PC version, the technology wasn't there to do that as well. I'm not sure . . . we didn't do the conversion for the PC version. And I'm not sure how they ended up handling that. On the Mac version, you'll walk into a room and anything you click on that has a sound effect will play while the music is playing. On the PC version, it does interrupt it. I think it's because the different types of soundcards can't necessarily handle more than one track of audio, so they had to do it differently.

Are you going to continue using audio as opposed to using a General MIDI soundtrack?

When you use the audio, you have so much more control. That's the one thing that scares me about using MIDI. I'm fearful of all the different kinds of General MIDI devices people will have.

And are they all going to be able to recreate the mood you were after.

Right, right. I mean, I've heard stuff done like that. Boy, it just scares me. I know some people are real proponents of that. I just don't know.

Where did the original inspiration for *Myst* come from?

Umm. I don't know! Rand and I have been wanting to do something that was for our own age ever since we started doing games back in 1987. *Myst* just kind of developed over the years until we finally sat down to do it.

So you had some ideas about islands?

We had some ideas, but no. Nothing about islands. As a matter of fact, we had come up with a story that was completely different. And in this strange kind of way *Myst* evolved from that other idea. The islands idea came out of trying to find a way of having natural boundaries put around a person. If you put somebody into a city in a CD-ROM game, they want to go walk down any street that they see. If they can't walk down that street, they feel gypped. Where if you put somebody next to an ocean and they can't go into the ocean, well that's okay. So islands create a good natural boundary. Another thing when we first started, I was reading a book called *Mysterious Island*, by Jules Verne. And there's a real Jules Verne feel in the whole game.

Anyway, I was reading *Mysterious Island* and I remember talking with Rand and saying, "Hey, let's call this thing *Mysterious Island*" — just joking. And we said, "How 'bout just Mysterious, or Mist. Or how 'bout Myst with a 'y.'" And we came up with the name before we even had a story. We kept the name, it was our code name, because it had a nice feel.

So now you're developing *Myst 2*. Will we see lots more full-screen animation and video?

There will be, but probably not in the way you expect. There have been some games where you see yourself moving from one area to another. They're really cool visually, but unfortunately, they take up so much room on the CD-ROM that you can't have as big of a world. And this world is going to be much bigger than the original *Myst*.

So you're concentrating on using your data segments wisely.

Right, right. We will want to have some full-screen animations, but I think they're going to be for more subtle things and for things that have to do more with the story, rather than just for pure flash. We want to fit as much onto the CD-ROM as possible. We want to use that space as wisely as possible. Because when a player has to wait because the flow between screens is impeded, the player gets really impatient.

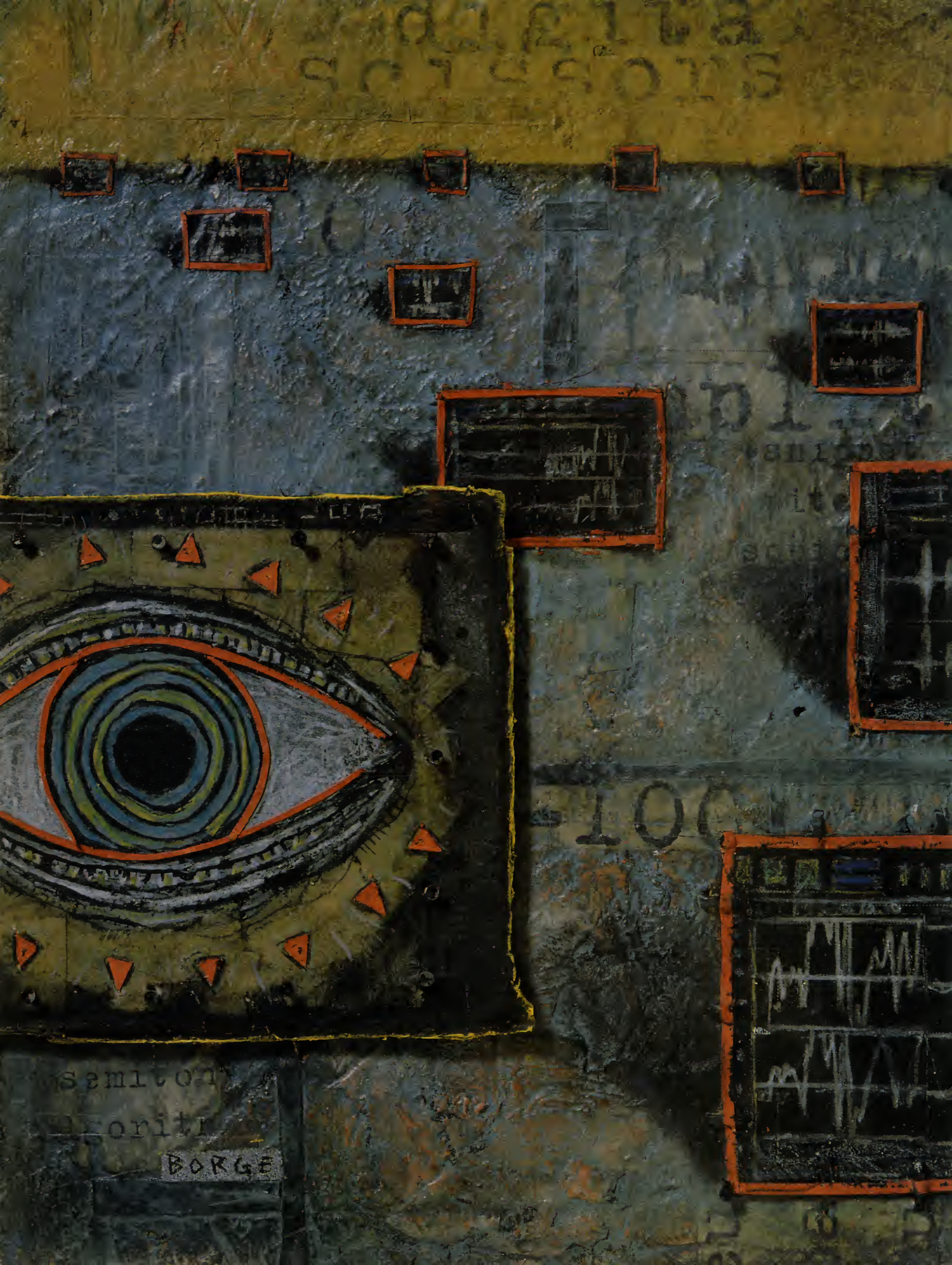
***The 7th Guest* suffers from that effect, because there's a limited number of vectors. You always have to go from point A to point B. If you're at point A, you can't skip point B to get to C.**

I can't even imagine playing *Myst* going at that rate. After a while, if the game is good enough and there're enough places, you want to just click click click, go forward and move through the world quickly. Even to the point where we had to add a zip mode. I can't imagine slowing it down even more than it already is.

***Myst* is a major hit. How much pressure are you under as a result of that success?**

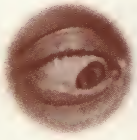
We are under pressure of our own making, because we want to do something that's better than what we've done. And we want to get it out there to people because they're waiting for it. We want to create it for people. We're not getting pressure from publishers or anything. Or at least we don't accept the pressure. But, yeah, we want to get *Myst 2* out as fast as possible. Fortunately, we're working with a publisher that recognizes it takes a lot of time to create good software. The pressure is definitely there. But we want to make it right.

We realized we couldn't have a lot of large movies, but movies seem a lot bigger if they're part of a larger picture.


BORGE

Seeing the Sound

Graphic **Waveform Editing** Demystified



Developers of multimedia tools regularly promote the advantages of manipulating digitally recorded audio. "Cut and paste music and effects." "Remove pops and clicks." "Create reverse, fade-out, and stuttering effects." And indeed, these tasks — and others far more complex — are easily accomplished using computer-based waveform editing programs such as Digidesign's Sound Designer II (Mac) or Turtle Beach's Wave for Windows (PC). For many, that first encounter with waveform editing software can prove to be, shall we say, daunting. Even if you're one of the initiated whose eyes don't glaze over at the sight of a waveform

By **Michael Marans**

Illustration: Rich Borge/Gravity Workshop

Seeing the Sound

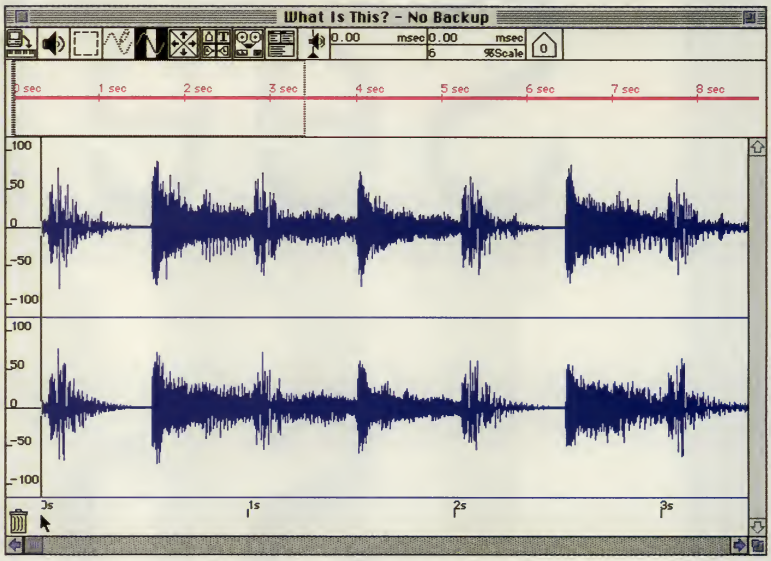


Fig. 1. For serious audio editing, most Macintosh users turn to Digidesign's Sound Designer II, shown here. With a bit of practice, you'll be able to identify clues in the waveform that reveal its audio content.

display, but you just aren't getting the results you want, read on. The following tips will help get you up and running — smoke and mirrors not required.

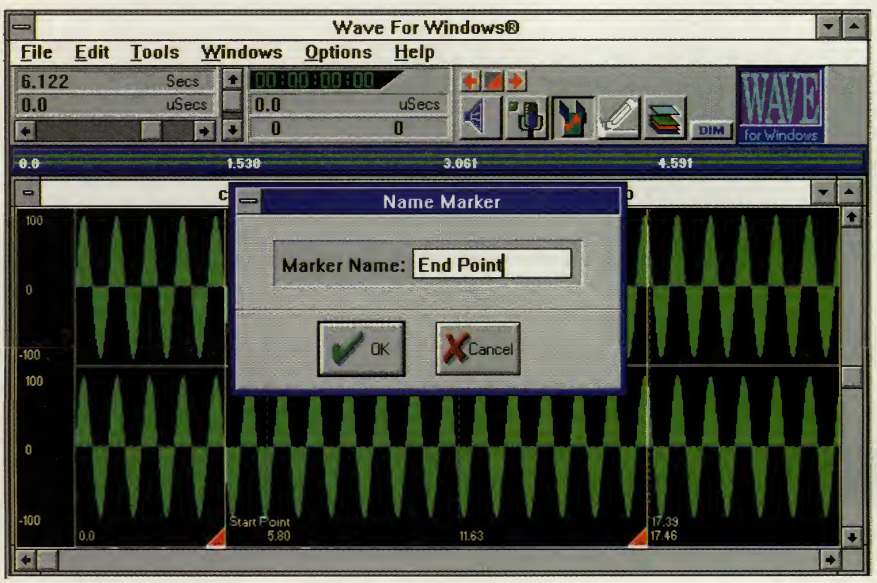
What the Heck Am I Looking at? One of the biggest challenges facing would-be audio editors is unfamiliarity with the main display used in audio editing software. Called *waveform views*, these windows display audio data as a series of dense squiggles — appropriate, perhaps, for electronic engineers and research scientists, but hardly intuitive for us mere mortals. Once you understand what you're seeing, however, you find that the squiggles reveal a horde of detailed information. Cracking this display "code" is half the battle: If you know how to read a map, there's a good chance you'll get where you're going.

Figure 1 is the waveform view in Sound Designer II. Ignore all the icons in the upper half of the screen and concentrate on the waveform display. The thin purple line immediately above the blue waveform is a timeline. It represents your entire file length, whether that's one second or 20 minutes. Its primary use is to locate and/or select specific points in the file. (Similar "overview" timelines are used in virtually all graphic waveform editing programs.). Conversely, the timeline indicates the area in the file that is being displayed in the main waveform view.

When you work with a monophonic file, the single-channel waveform will occupy the entire waveform view window. In the case of a stereo file, as in our example, the screen is evenly divided between the left and right sides of the stereo signal, with the left side above the right. As in the timeline, the waveform view also shows time reading from left to right. The waveform's volume — officially known as *amplitude* — is displayed on the vertical axis on either side of a center line running horizontally through the middle of the waveform. Why on two sides instead of simply from bottom to top? Analog waveforms actually consist of both positive and negative voltages, in accordance with the *phase* of the waveform at any given moment in time. When a wave is digitally recorded, these voltages are represented as specific sample values. In a waveform editing screen, displaying data on either side of a center line allows the waveform's phase characteristics to be shown as well as its amplitude.

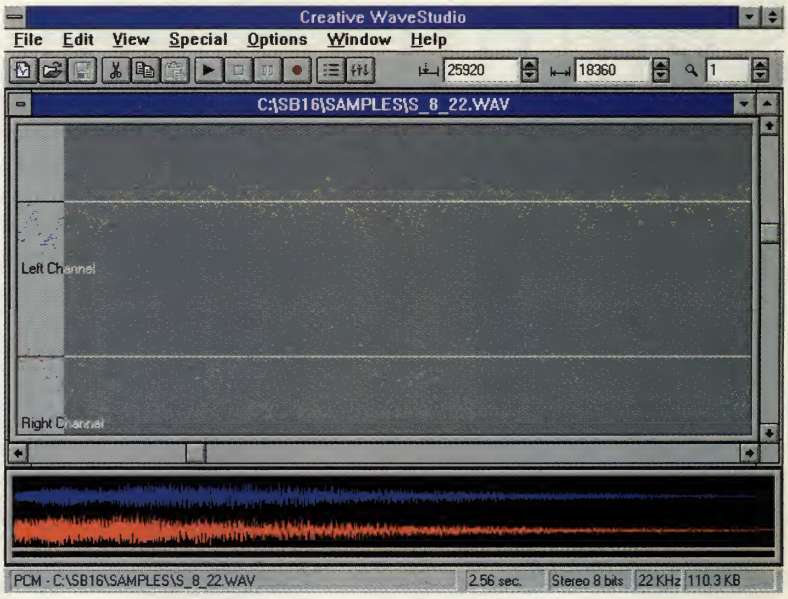
In the digital domain, we express volume as a percent of *full scale*, with 100% of full scale being the maximum possible pre-*clipping* (a nasty type of distortion) volume. In a waveform view, the center line has a value of 0% full scale; when a waveform crosses the center line, it has no amplitude and, hence, makes no sound. (This is a very important point, as we'll see later.) When you see a waveform peak that reaches the top of the display, that peak will have a display value of 100% full scale. A peak that reaches the bottom of the display also has a value of 100% full scale, but because of its phase, the

Popular among Windows users are Turtle Beach's Wave for Windows and its sister program Waves SE. In this example, an area of the waveform has been selected for editing; the boundaries of the region are identified with markers, so that the region can later be easily relocated. Markers can be named for easy identification.



value will be displayed as –100. It's important to note that phase does not affect volume. The +100 peak and the –100 peak are equally loud.

Our waveform display is filled with about one bar (3.35 seconds) of pop music. You wouldn't necessarily know that only by looking at it, but there are clues in the shape and pattern of the waveform that would make that assumption reasonable. First, there are obvious sharp peaks — called *transients* — that occur at regularly spaced intervals. These transients, you'll notice, extend equally on either side of each channel's center lines. The peaks' onsets are very sudden (evidenced by their flat leading edges), they are not very long in terms of time, and each one is followed by a section of waveform that gradually tapers toward the center line as the amplitude fades. From this visual information, we can tell that these peaks (a) have very fast, sharp attacks, (b) are relatively loud as compared to the waveform's average volume, (c) don't last very long, and (d) due to the evenness of their spacing, are rhythmic in nature. Put those four things together and you might reasonably conclude that these transients are the drums in a piece of music. And, in fact, that's precisely what they are.



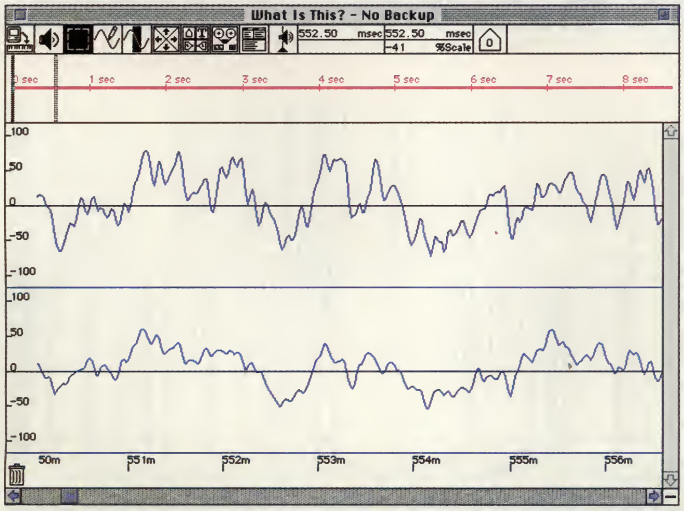
Most waveform editors that come bundled with soundcards aren't up to the task of professional level editing. In this example, zooming in for a close look at the waveform presents the user with a bunch of meaningless dots.

Further confirmation that you're looking at music comes in the form of pattern repetition. For example, in Figure 1, the largest transients are separated by equal amounts of similarly shaped wave data. Notice too, that the transients repeat at regular, identifiable intervals. The practiced eye of a musician/sound designer might be able to spot these transients as a snare drum playing on beats two and four in successive bars of music. Note the distance between the snare transients (the second, fourth, and sixth peaks in the display). We know this distance is two beats, so half the distance would be one beat. Let your eyes travel halfway between any two snare transients and you'll see another similarly shaped transient, but one whose amplitude is somewhat smaller. That's the kick drum playing on beats one and three. Once you've located the basic drum beats in your waveform, you should have little trouble spotting accents and pickups.

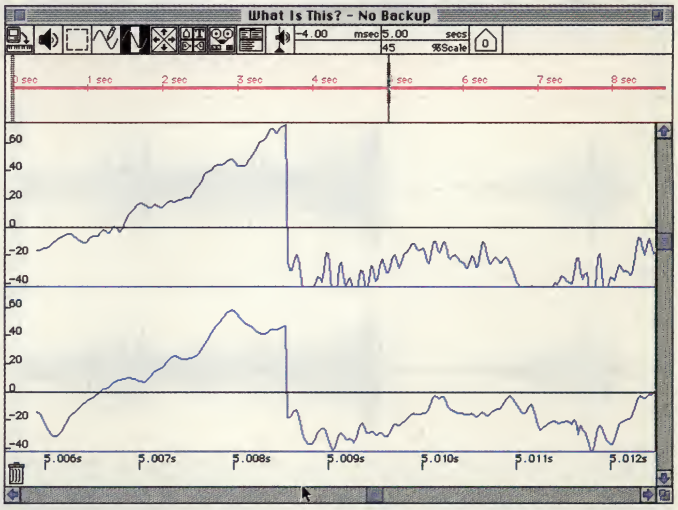
It then becomes easy to identify a basic 4/4 groove in a piece of music — just count the kick and snare transients. With this bar-long anchor in hand, you can move about a tune cutting and pasting sections of wave data at precise locations. Well, almost. Precision editing — the stuff that computers are so darned good at — requires coming in for a closer look.

Fig 2. When you take a very close at a waveform, you can see that it progresses smoothly from one sample to the next (2a). If you make an edit that causes discontinuity in the wave (2b) you'll get an undesirable pop or click during playback.

2a.



2b.



Seeing the Sound

Zooming Around. One of the marvels of digital audio editing is that you can make edits with an amazing degree of accuracy. In essence, you can cut and paste with single-sample resolution. Working with files recorded at the professional (i.e., CD-quality) 44.1kHz sample rate means you have editing precision of one 44,100th of a second. Why, you may ask, do you need to be so precise? No one is going to be able to tell if your pasted data is off by a couple of thousandths of a second. Musical considerations aside, the main reason you need pin-point accuracy is because a digital waveform must progress smoothly from one sample value to another as it plays out (Figure 2a). If there is discontinuity in the wave — for example, a sample with a +75 value is followed by sample with a value of –30 (Figure 2b) — you'll get a tick, pop, or other unpleasant artifact in your audio. For this reason, all digital edits should be performed only at the points where the waveform's amplitude is at 0% full scale — the *zero crossings*. When you edit at zero crossings, you can, for the most part, be assured your edits will be smooth and glitch-free.

The trick to using zoom magnification successfully is to proceed carefully and in stages. Once you start zooming in on a wave, it's very easy to get lost. Before you know it, you can have the entire waveform view filled with the most infinitesimal portion of a wave (Figure 3). What you see at that point may be exceptionally disorienting, especially if you've overmagnified the Y (vertical) axis. You're also more likely to get into trouble if you're using a non-industrial-strength waveform editor, such as those packaged with the cheaper soundcards. Many of these don't have the resolution to display contiguous waveform data at the highest magnification levels. Instead of a nice clean line, you get a series of meaningless dots. Forget doing all but the coarsest of edits with those programs.

To avoid getting into trouble, it's best to select the start and/or end points of the region you wish to edit while in a zoomed-out view, where lots of data is showing. You likely won't nail the points exactly, but you should be able to get pretty close. Now zoom in to the next level. Depending on the program you're using, you may wish to place markers at the selected points (recommended for Wave for Windows).

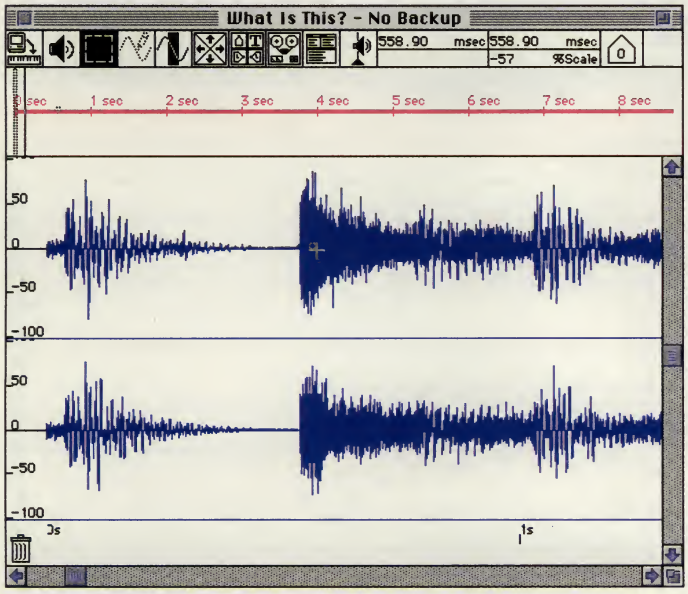
One of the most efficient ways to zoom in is to use a drag-and-draw box to select successively smaller areas of data to view. This affords you complete control over the degree of magnification, and eliminates the annoying problem of having the start point of your edit disappear off screen after increasing the X axis magnification. Figure 4 shows the successive zoom views used to zero-in on the beginning of a snare transient. Notice that the shape of the drag-and-draw box affects how the data will be displayed: A square box magnifies the X and Y axis equally, whereas a rectangular box magnifies one axis more than the other according to the shape of the rectangle. This is very helpful when you're zooming in on an edit point that's in the middle of other relatively dense data. To determine the shape of the drag-and-draw box, look for something identifiable in the waveform and place the box in such a way that the identifiable portion will either be retained or exaggerated.

Practical Matters. Let's say you want to add a recorded sound effect to your MIDI sequence, CD-ROM, business presentation, or what have you. Assuming you recorded the effect yourself (in .WAV, AIFF, or some such format), it's likely that it's going to need some tidying up — removing dead air from the beginning, cutting it down to size, etc. Those two procedures will be the goal of this exercise.

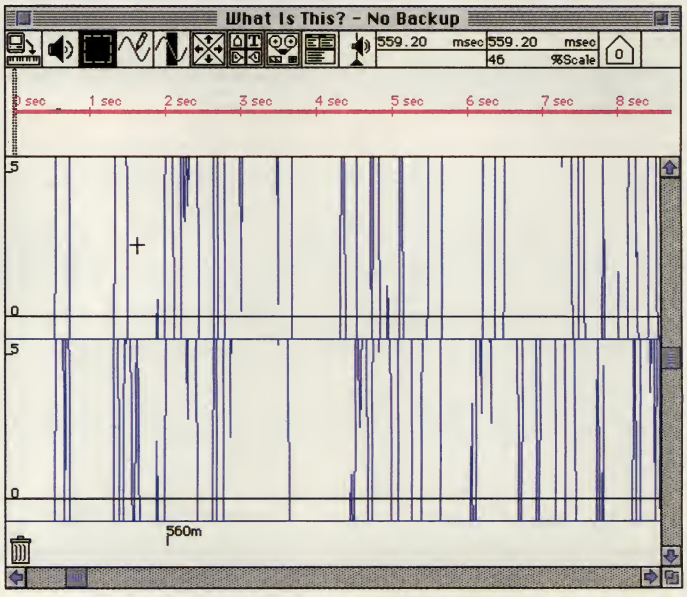
Start by loading the file into your waveform editing program. We've chosen to work with the voice-over phrase, "Multimedia Extravaganza!" (Figure 5). You can immediately see a number of the individual syllables (unfortunately you can't discern from the display the powerful emotive force behind the reading of the words). You'll also notice the dead air at the beginning of the

Fig. 3. Zooming in on a waveform is a standard procedure when editing digital audio. You have to zoom in carefully, however. Select too small of an area (3a) and you could end up with an indecipherable display (3b).

3a.



3b.



phrase. Time to get out the digital scissors.

The first part of our task is to select the area from the beginning of the file up to the exact point where the word "multimedia" begins. We're selecting this area so that it can be removed. We'll start by zooming in on the beginning of the word "multimedia." Drawing a box around the portion of the file where the "m" in multimedia starts presents us with the view in Figure 6a. We can see more clearly now where the "m" actually starts: It's the first curvy part of the wave that rises from the straight line to its left. The line is noise — in this case, fan noise from our computer that was picked up by the live microphone. Successive zooms bring us to the view in Figure 6b. Here we can see the exact point where the noise ends and the "m" begins — the place where we want to make our edit. Remember that your edit point must be at a zero crossing.

Once the edit point is marked, zoom out so you can see the beginning of the waveform. We want to select the very beginning of the file so that we can complete the definition of our edit region. But if we simply select the start of the file by clicking on it, we'll lose our current edit point at the "m." To prevent this from occurring, hold down the SHIFT key when

Fig. 4. Zoom magnification is essential for insuring that your edits are made at zero crossings. In this example, a drag-and-draw box is used to select the portion of the waveform that will be magnified. In each step in the series, notice how the shape of the selection box directly correlates to the waveform data that's displayed.

Fig. 4a.

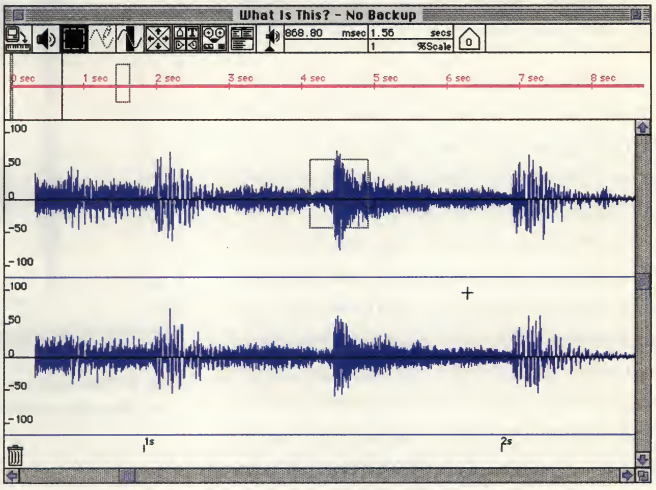


Fig. 4b.

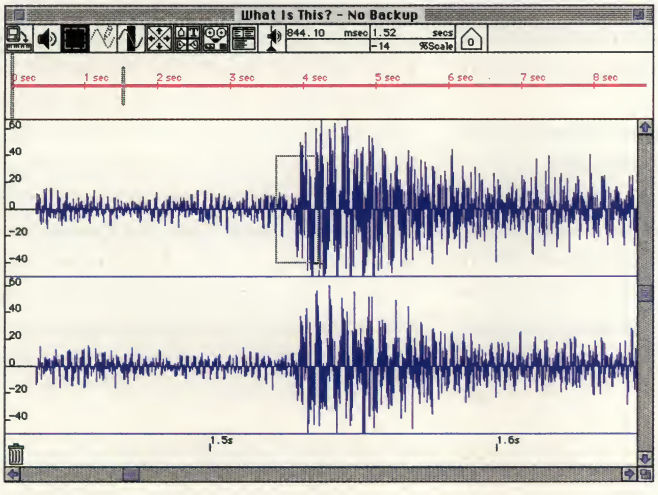


Fig. 4c.

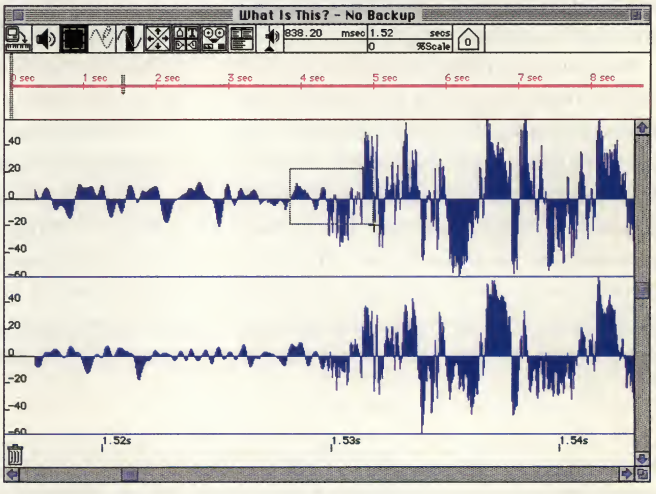


Fig. 4d.

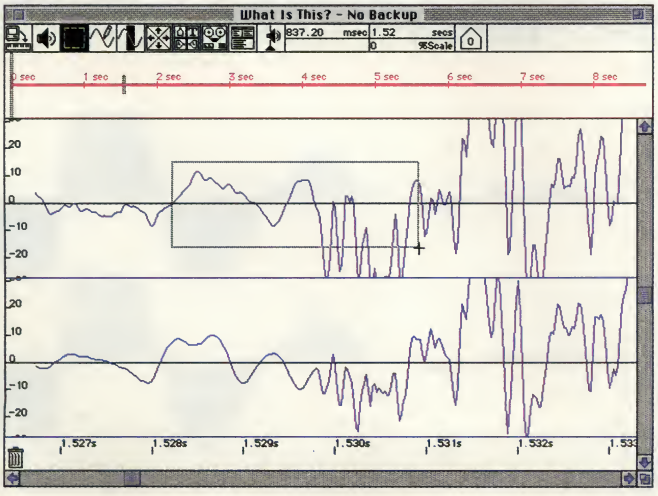
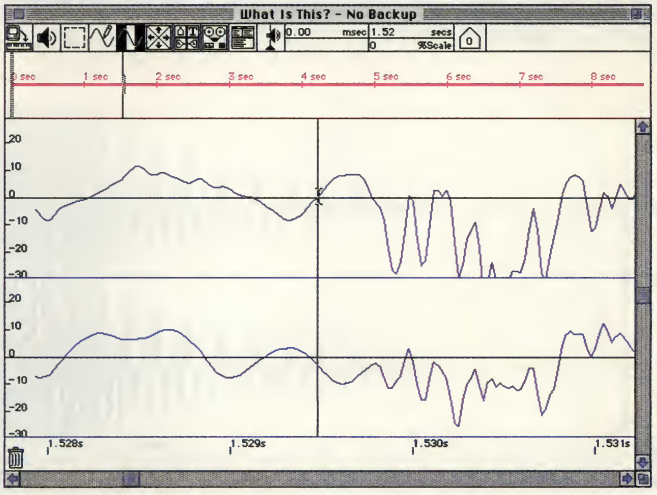


Fig. 4e.



Seeing the Sound

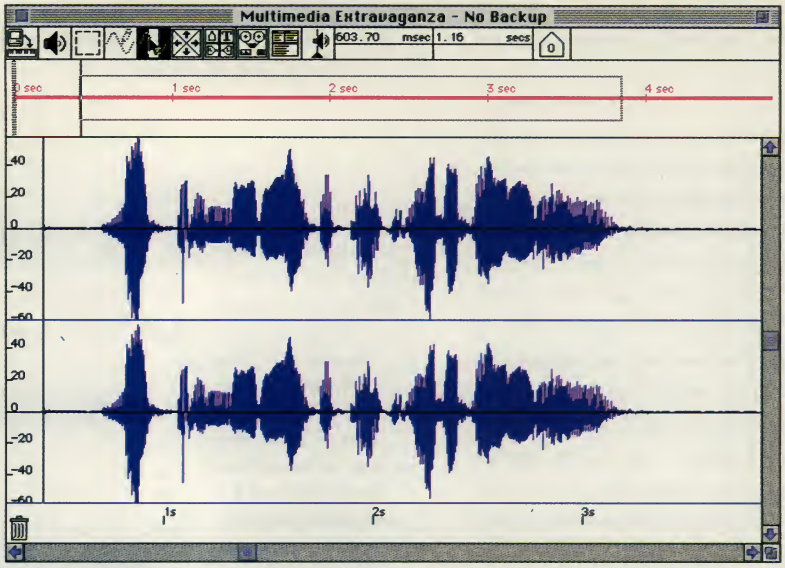


Fig. 5. You can see the individual syllables in the waveform of the spoken phrase, "multimedia extravaganza."

you select the second edit point. When you do this, all data between the two points will be highlighted, indicating that it has been selected for editing. Execute a CUT or DELETE command to remove the data.

The final step is to remove unwanted data at the end of the file. If you want to retain the entire file except for extraneous noise at the end, simply repeat the above procedure using the desired end of the file as the first edit point and the actual end of the file as the second end point. To remove more of the file — say, the word "extravaganza" — simply adjust the first edit point accordingly. The same technique can, of course, be used to isolate specific sections of a file — a musical phrase, a snippet of speech, a single effect out of a group, and so on.

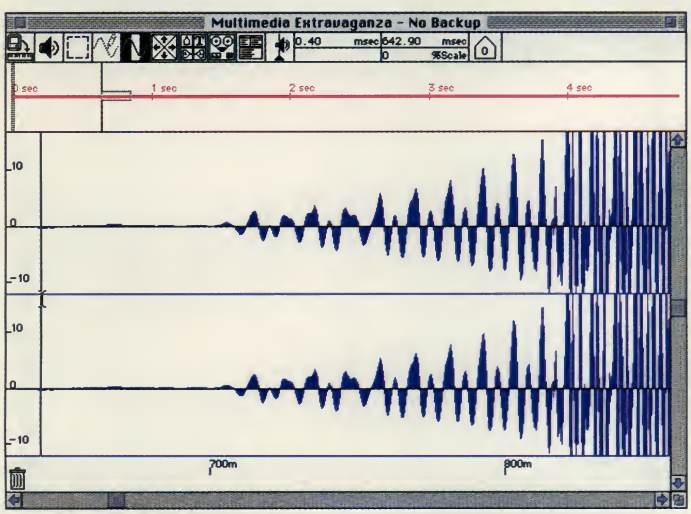
You Have Everything to Gain. Once you've defined a region for editing, you certainly aren't limited to simple cut and paste operations. Digital audio editing programs contain a host of processing functions that allow you to mangle your waveforms into oblivion. Some of these processes are simply utilitarian. Others are gateways to unbridled creativity. All of them should be performed with your program's UNDO EDIT function enabled. These are destructive, permanent processes; if you don't like the results, you're stuck unless you can execute an UNDO command.

Some of the most important utilities are those related to the waveform's amplitude.

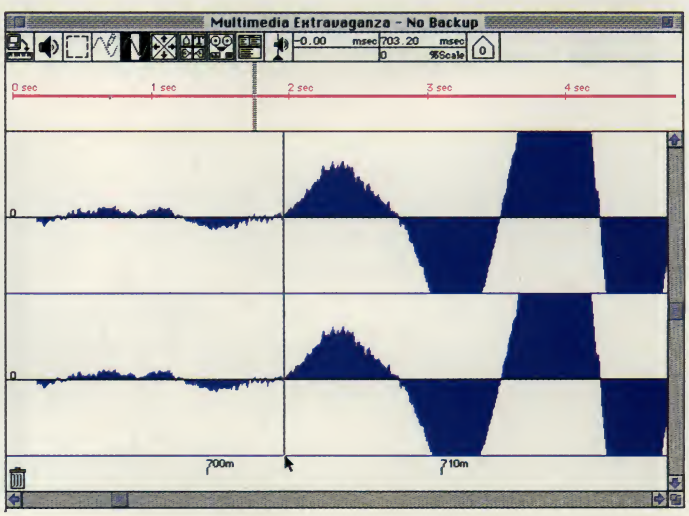
• *Gain Normalization.* This utility ensures that your soundfile plays at its maximum volume, thus optimizing the signal-to-noise (s/n) ratio. It works by first scanning the file for the loudest peak, then adjusting the peak's amplitude to 100% full scale while raising the volume of the rest of the file proportionately. In waveforms where a peak is substantially louder than the rest of the file, normalization may only provide minimal benefits, as the peak may be at or near 100% full scale with the rest of the file being considerably lower. In these cases, select the peak of the wave (drag across the entire peak with the mouse — don't forget to use zoom views and zero crossings) and use the CHANGE GAIN function to lower the peak's amplitude by a small amount (start with one or two dB). In

Fig. 6. To find our edit point, we use a drag-and-draw box to zoom in on the "m" in the word "multimedia." The zooming is performed in successive steps, with each step revealing more detail as to the exact start of the "m."

6a.



6b.



essence, this provides more "headroom" for the normalization routine, allowing the lower-level portions of the waveform to be boosted by a greater amount.

• *Fade-In/Fade-Out.* These operations are the digital equivalents of moving a volume fader on a mixer. But since they always take the data to 0% full scale (at the beginning of the edit region in the case of fade-in; at the end for fade-out) their applications are somewhat limited. They can, however, be used to great effect to make the intro or ending of a file sound more natural than a straight-ahead cut to silence. Handy hint: By selecting an edit region that extends beyond the area to be faded, you can effectively control the shape of the fade.

• *Gain Adjust.* If you're running Wave for Windows and want to create a fade that doesn't go to 0% full scale, use GAIN ADJUST rather than fade-in or -out. This utility offers a lot of flexibility, as it allows you to set the amplitude of the start and end points of the edit region. You could, for example, use it to duck (techno-speak for reduce the volume of) a music bed so that a voice-over can be heard more clearly. This is a three step process. First, select a portion at the beginning of the file and fade to the desired level (say, 3dB down) by setting the start point level to 0dB and the end point level to –3dB. Next, select the portion of the file that is to play during the voice-over and set the start and end point levels to –3dB (or whatever level you used for the original fade). Finally, select the remaining region at the end file and set its start point level to –3dB and end point level to 0dB.

Getting Small. Musicians who use samplers have traditionally been plagued by one unrelenting fact of life in the digital world: There's never enough memory. That truism goes double for multimedia. CD-ROM space is limited by having to reserve the majority of memory for graphics and animation. Hard disk space is always at premium, and at 10Mb per minute of stereo 16-bit 44.1kHz audio, the temptation to cut audio corners can run pretty high. With a graphic waveform editor, however, you can conserve memory using many of the same tricks musicians have come to rely on. While some of these techniques won't gain you a ton of space, their cumulative effect can be substantial.

• *Cut It Loose.* The easiest way to gain memory is to eliminate any and all unnecessary data from your file. This also gives you the benefit of knowing that your file will fire immediately when triggered, which makes for better timing accuracy.

• *Get a Tune-Up.* Pitch-shifting a file upwards makes it shorter. The amount of pitch-shifting you'll be able to perform without adversely affecting the sound will depend on the type of material your file contains. Digital samples are subject to *munchkinization* — a.k.a. the Mickey Mouse effect — when pitch-shifted upward. This is because their formant series shifts upwards as well, rather than remaining constant, as is the case with acoustic instruments. If you're working with full program material, you'll only be able to shift upwards a semitone or two before the munchkinization becomes obviously objectionable. Ditto for speech. Sound effects, on the other hand, tend to be more forgiving, as do some solo instruments.

> Musical considerations aside, the main reason you need pin-point accuracy is because a digital waveform must progress smoothly from one sample value to another.

• *Time for a Change.* If pitch-shifting upwards disturbs the file's sonic integrity by an unacceptable amount, try using a time compression algorithm instead. With this process, the file can be shortened without affecting its pitch. Of course, nothing comes for free. Time compression can also cause undesirable artifacts. For this reason, a good time compression algorithm will offer you operational choices, wherein you can balance the effectiveness of the time compression against the potential for sonic artifacts. There are no rules for which settings provide the best results, so be prepared to "undo" as necessary.

• *Get Converted.* We almost hate to bring this subject up as its two elements — *sample rate conversion* and *bit-rate conversion* — are the most dastardly contributors to the overall poor quality sound we suffer through in multimedia titles. Nonetheless, they are (for now) the hands-down winners in the memory conservation race. The trick is to try to minimize their negative impact.

For sample rate conversions, first perform an FFT (fast fourier transform) on your file so that you can determine its frequency content. As a rule of thumb, you can record and/or play back frequencies up to around 40% of a given sample rate (the *theoretical* maximum is 50%). So, for example, a 44.1kHz rate will yield a frequency response of around 17.6kHz, whereas a 20.050kHz rate will only reproduce frequencies up to around 8.2kHz. If your file contains significant high-frequency energy, try to avoid converting the sample rate downward. By the way, converting upward will not enhance the fidelity of a sample recorded at a lower rate — you can't get back what you never had in the first place.

There are no mysteries to converting a sample from 16-bit resolution to 8-bit resolution. Without question, the sample will sound worse. One promising hope: L1, a new software plug-in module for Sound Designer II. The program, from the Israeli company Waves, reportedly allows you to convert files to 8-bit resolution while maintaining a sound quality associated with higher resolutions (8 to 12 bits). Here's hoping.

• • • •

We've only begun to scratch the surface of the world of waveform editing. With the onboard Digital Signal Processing (DSP) offered by professional programs, the creative possibilities are virtually endless — equalization, dynamics processing, merging and mixing of files, noise reduction, effects processing, and much more. We hope to get to those in the near future. Until then, may all your zeroes be crossed and your gains normalized.


House Jam
REC

Suite Multimedia

(Almost) Everything You Need to Know to Put Together a CD-ROM Authoring Suite

By Guy Wright & Dominic Milano

You've got a brilliant idea. A new game. A novel way to turn your print publication into an interactive multimedia extravaganze. A bunch of video and still graphics that would be perfect as electronic clip art. . . . No matter what your concept, if you're talking multimedia, you can't help talking about about the delivery media *du jour* — CD-ROM. ■ The huge quantities of digital information required in even the most modest multimedia presentation make working from traditional storage media such as floppies problematic. Hard disks, ideal for fast throughput and mass storage, are far from portable. And if you're developing commercial products for distribution, a hard drive doesn't come close to being an option as a delivery system. CD-ROMs,

Illustration: Marcos Sorenson

Suite Multimedia

on the other hand, offer vast storage capacity, multi-format multi-platform capabilities, high quality digital audio, video, MIDI, durability, and — most of all — low-cost. They're an elegant solution that birthed an industry that everyone and their sister wants to be a part of.

For the uninitiated, the process of CD-ROM production may seem alien. Unless you're already an experienced CD-ROM developer, or have copious amounts of time to research all the options, building a CD-ROM authoring suite is likely to be a painstaking, budget-breaking process of trail and error.

What new equipment will you need? Will the gear you own now be of any use? How close to bankruptcy will you be after loading up on all the stuff you'll need? We can't possibly provide answers or solutions to every need that could crop up during the course of building a multimedia authoring suite in the space we've got here. But we can take a shot at providing an in-depth primer on the subject. How relevant each of the following sections will be to you depends on your individual situation, your goals, the nature of your project, and your bank balance.

From the Brains Up

The heart (or brains) of any multimedia suite are its computers. No matter what sort of application you're building, you need computers. A lot of computers. (Though it *is* possible to develop a CD-ROM on a single machine, you may want separate systems that have been optimized for developing the audio, 3D graphics, or video portions of your product, bringing all the separate elements together when they're completed on whatever system you put together that's optimized as an authoring platform.) What computers you populate your suite with depend on what platform(s) you're developing for. Mac, PC, CD-I, Sega-CD, kiosks, and so on all require different computers as development systems. There are, however, a few guidelines you can follow no matter what.

The Silicon Graphics Solution

If photorealistic 3D modeling, computer animation, or broadcast-quality video work play major roles in your development plans, highend Macs and PCs may not have the horsepower to convert your visions to realities in your lifetime. Or so it could seem. Where a Quadra might take eight hours to render a complex 3D image, a Silicon Graphics workstation might take under a minute, that is if the image is complex enough.

SGI has long dominated the entertainment industry as its special effects engine of choice, but the Indy and Indigo 2 lines put the power of highend Unix-based workstations within reach of those of us with budgets slightly smaller than that of, say, Industrial Light & Magic. Optimized for graphics processing speed and networking capabilities, SGI machines make Herculean development platforms, but at these prices (an Indy runs $5,000; Indigo 2s start at $15,000 and run up to $30,000), don't count on making them mass market target platforms.

While there's a shortage of SGI-based multimedia authoring system software for integrating elements from diverse applications (though Silicon Graphics has formed a new company, Silicon Studio, to develop such tools), graphics and video files created on an SGI machine can be exported to a Mac or PC via Ethernet for further authoring within a Mac or Windows environment. And the $5,000 you plop down on an Indy includes its keyboard, a 16" 24-bit color monitor, onboard 16-bit, 4-channel digital audio, graphic waveform editing software, and video capabilities featuring two analog S- and composite video-ins supporting both NTSC and PAL, digital

video input, and a digital video camera — features you'd pay much more for on a comparably equipped Mac or PC.

And here's a bit of culture shock — the software often costs more than the computer. For example, the Matador program used by such companies as ILM checks in at $20,000 *per copy*. Softlmage, another highly popular 3D modeling and animation package starts at $7,000 and can run as high as $55,000. But the images these programs put out can be as spectacular as their price tags. And in the right hands with the right clients, an SGI system can quickly pay for itself.

A typical Indy system configuration: the Indy XZ, with SGI Geometry Engine accelerated graphics, a 16" 24-bit color monitor, 64 megs of RAM minimum (256 megs max), a 1-gig hard drive, CD-ROM drive, DAT drive for backup, and perhaps a graphics tablet.

First, you'll need both a development platform and a testing, or target, platform. The development platform should be a full-blown system, while the target machine will be a duplicate of the type of system your customers are likely to use.

If you're developing for the consumer market, the testing platform should be a least common denominator system: minimum RAM, single-speed CD-ROM drive, slow processor, and the cheapest sound and video your customers are likely to have access to. If you know your CD-ROMs will only be used on systems with SVGA cards, 16-bit audio, and triple-speed drives, put together your test system accordingly. But if your product is for general consumption, don't take anything for granted. If you can get your discs to run on a bottom-of-the-line system, it'll probably work on any system, though you should test performance on faster systems just to be sure. If you can afford it, put together your testing system(s) with a variety of sound and video cards, CD-ROM drives (various speeds and brands), RAM configurations, peripherals, and so on. What you spend on testing up front, will more than make up for what you might have to spend on customer support, and lost sales, on the back-end of your product's development cycle.

In the PC world, your biggest problems are going to fall on peripherals such as sound and video cards. Because there are literally thousands of possible configurations, you're guaranteed to run into compatibility problems somewhere down the road. In some cases, there are peripherals leading the pack, such as the Sound Blaster line of audio cards, but when it comes to video, there's no clear leader. At a minimum, your target machine should have VGA, SVGA, and monochrome options (yes, there are a lot of monochrome systems out there and people are beginning to put CD-ROM drives in portables). You might also think about configuring your target system with a 33MHz CPU, no math co-processor, a single-speed CD-ROM drive, and only 4MB of RAM. While most of us realize that 4MB is nowhere near enough for multimedia, those are the configurations being sold today as "multimedia ready." You should also test your product under DOS and various versions of Windows (if that's your intended market). Also, test it with and without sound card support.

Mac test platforms considerations will also center on the amount of RAM, the operating system, monitor size, and which 680X0 processor is used. Fortunately, the built-in Mac sound and video are known quantities and your target system should probably go no farther, unless you're certain your audience will have something other

To PowerPC or Not to PowerPC

Touted as faster than a speeding bullet and able to leap huge files in a single bound, the PowerPC sports a CPU developed jointly by Apple, IBM, and Motorola. The first generation machines, the PowerMac built by Apple, are based on IBM's PPC601 chip, which have been clocked as two to five times faster than the 68CL040 used in Apple's Quadras. The next generation PowerPC CPUs, due out next year, are supposed to be even faster.

The PowerMac sounds even more impressive when you consider the ads that claim they can run both Windows and Mac software. They come two built-in video cards. The AV models feature 16-bit audio capabilities. It may be too early to consider the PowerPC as a target platform, but the question is, are they *the* ideal multimedia development platform?

That depends.

They do have a lot to offer. But they've also got a few Achilles heels. Their processor is not directly backward compatible with 680X0 CPUs. To run System 7-based Mac software, the PowerMac has to run an app that emulates a Quadra's 68LC040 processor. The problem is, a PowerMac emulating a 68LC040 isn't as fast as a machine with a real 68LC040.

That means to take advantage of the PowerMac's speed, you'll need "native" apps, i.e. software written specifically for the PowerMac. The good news is that tons of native graphics and animation software is already available and more is on the way. A number of powerful music apps — MIDI sequencers and notation programs — are available now, and some companies have plans to support the PowerMac AV's onboard 16-bit digital audio capabilities (Opcode should be shipping Studio Vision AV in native code by the time you read this). The bad news is that Opcode describes the PowerMac's own digital audio as less-than-pro-quality. For those needing highend digital audio support, the bad news is Digidesign (who have a virtual lock on the Mac digital audio pro market) and a host of developers who support Digi products are currently taking a wait and see attitude towards the PowerMac.

Why? Because Apple plans to replace the NuBus expansion slots with wider bandwidth PCI slots by early next year. Even the current generation NuBus-equipped PowerMacs have trouble running realtime audio apps, because some parts of System 7 required for the realtime work are non-native code. So it's still faster to run realtime apps in emulation mode. And if you're hoping to run your old Windows-based music software or use a Soundblaster or some other digital audio card, think again. They're incompatible with the PowerPC. So if audio is your thing, you might do better waiting six months or so. Folks looking for graphics and animation muscle who can afford to buy a bunch of new software have plenty of reason to take the PowerPC plunge right here, right now.

Suite Multimedia

than a standard system. The most generic Mac is currently a 4MB 68030, 8-bit color Mac (such as an LC or Performa) running either system 6.X, system 7, or 7.1. You should test B&W, and you might also test under system 7.5. If you can, run your trials on systems with 12", 14", and 16" monitors. If you have to limit yourself to one, go with a 14" monitor.

Most other systems, such as CD-I, Sega-CD, Sony SP-X, or custom hardware make the target choice easy, because there are either few or no configuration options. Likewise, development system requirements are proprietary. You'll need to contact the manufacturer of the particular system you're interested in for specifics on how to become an authorized developer, licensing information, and so on.

Development Platforms. At the other extreme, Mac and PC/Windows development platforms are going to need a lot of horsepower, RAM, expansion slots, and storage capacity — more than most people are likely to have for more casual uses. A typical Windows development system might be a 66MHz 486 or Pentium machine with 32+MB of RAM and at least a gigabyte of fast-access hard disk space. More than likely, you'll also want a tape drive, removable cartridge media, magneto-optical, or WORM drive for storage and backup. And then there are the special peripherals and cards for which your system will need lots of expansion slots, but we'll get to that shortly.

The same goes for Mac-based development systems. The bigger and faster, with as much RAM and hard disk space as possible is the rule of the day. And don't forget expansion slots. You'll need plenty of them for peripherals such as digital audio cards, graphics accelerator boards, DSP (Digital Signal Processing) farms, video cards, and on and on. A typical system: a Quadra 950 with 20 to 64+ megs of RAM, 24-bit color card with a 19" two-page monitor, a one-gig hard drive, a SyQuest drive, and sundry peripherals.

Why do you need a such a high-power system? You might think you could get away with a lot less, and in some cases you could. But as soon as you say "multimedia," the requirements jump through the roof. Let's say you'd like to include still graphics in your product. An 8-1/2"x11" image scanned at 300dpi in 24-bit color will take up about 20MB. With most scanners, you won't be able to scan it unless you have that much RAM in your system, plus a few more megs for the operating system and scanner software. Twenty such images will nearly fill a 500MB hard drive. Even when converted to the typical 640x400 image, you'll still need more than a megabyte per graphic. Digitized audio (8-bit mono .WAV files at a 22kHz sample rate) consumes about a meg a minute. Stereo, 16-bit CD-quality audio takes about 10MB per minute, and video (320x240, 16-color, 8-bit audio at 15-frames-per-second) eats about one meg for each 10 seconds. And check this out: Non-compressed, full-motion video devours roughly 900k of memory per *frame*, which works out to about 27MB per *second* to record and play in real time!

> Bigger and faster is the rule of the day.

The bottom line: Your development system has to be able to handle large files for manipulation, conversion, and prototyping. You'll also have to temporarily store them on hard disk. Since you won't want to go back and re-digitize when converting to other formats, you'll want to save raw files on some mass storage media. And for all the prerequisite peripherals, you'll need a system with as many expansion slots as you can get.

Thingamabobs, Whozamagiggers, and Peripherals

Graphics, audio, and video take up a lot of space and require a ton of processing power to develop, but you have to have a way to get them into your computer in the first place. That's where some of the more specialized peripherals enter the picture. You may not need all of the following pieces of gear, but we'll talk about them anyway, leaving specific choices for you to determine based on your particular needs.

Audio. Most multimedia projects involve some sort of audio, be it digitized music, sound effects, narration, or MIDI files. These elements fall into three broad categories — CD audio, MIDI, and digitized audio. The first type, CD audio (a.k.a. Red Book) is exactly what you get on a traditional music compact disc. It's audio sampled at 44.1kHz producing a signal that can be stored on disc in digital form. It can be played back on any CD player and it's very high quality. That quality, however, comes with a price. First, it consumes a lot of storage space. Second, when Red Book audio stored on a standard CD-ROM is playing, you cannot access any other information from disc. Therefore, you've got to preload any graphics, animation, or program information before switching on the CD audio, and you must wait until the CD audio is switched off before you can load anything else.

Getting CD audio onto a CD-ROM disc is not all that difficult. When you send your computer data to be mastered or pre-mastered, you send along a DAT (digital audio tape) that contains your audio tracks. The mastering facility puts everything on the disc for you — computer information on track 1 and audio on tracks 2 on up (the practical limit is just over 100 tracks). What you as a developer have to be concerned with is the quality of the audio you send to the mastering facility — one reason why most people use the DAT format. Of course, using good recording equipment doesn't assure the quality of the audio stored on it.

You don't necessarily need a full-blown music production facility to produce quality audio sound tracks, though if you've got a really deep-pockets budget and have grandious audio ideas, it wouldn't hurt. Of course, contracting your audio requirements out is always an option. Freelance composers and sound designers more often than not have well-endowed home studios and can turn out DAT masters without needing to resort to going out to more costly professional facilities. And you can always go to a professional recording studio to get your audio needs mastered to DAT. Whatever course you choose, you'll want to have at least a DAT recorder and some kind of playback system (powered monitors of some sort) on hand at your facility so you can listen to your DAT masters.

Another audio option with some pretty compelling advantages is offered by MIDI — the Musical Instrument Digital Interface. MIDI is a digital communications protocol that contains musical performance information. It tells MIDI devices, such as synthesizers, sound modules, or computer soundcards what notes to play, when to play them, how long and how loud they should be played, and so on. MIDI data can be encoded into a CD at the mastering

Continued on page 61

Toys for Bob

A Virtual Studio

By Kathleen Maher

A bank building in the quiet town of Novato, on the edge of Northern California's wine country, seems a more likely site for a dentist's office than a multimedia development suite, but it's home for a number of developers, including Paul Reiche and Ken and Fred Ford, who as Toys for Bob do game development contract work for Crystal Dynamics. While the Toys for Bob office is littered with computers, the firm shares resources with the other developers in the building, and relies on freelance artists, animators, sound designers, musicians, and video teams. "We structure ourselves," says Paul Reiche, "so we do the

Toys for Bob: Paul Reiche (center) with Ken and Fred Ford

Photos: Gary Laufman

Toys for Bob

programming and design, then find the best people for the job as the project develops."

For Reiche, it's the only sort of structure that makes sense. The economical advantage is obvious. Toys for Bob doesn't have to maintain a staff, cover a large payroll, or get locked into any particular equipment. This gives them the flexibility to hire the best people, who in turn supply their own gear, for whatever the job may be.

Which gives Reiche and the Ford brothers plenty of room to experiment with different techniques. For example, *The Horde* — a quirky, funny game — uses a great deal of live action video to tell its story; whereas *Star Control* involves 3D animation, starships, aliens, and plenty of role playing. For each, Reiche sent work out to different teams. "Otherwise," he explains, "we'd say, 'Full-motion video? 3D animation?' We're gonna need four Alias stations (SGI machines running Alias software). That's $150,000 each. And we have to get trained people whom, when the project's over, I'd still have to be employing . . . We don't want to buy a studio we don't know how to use."

Even so, the Toys for Bob office is filled with computers. In general they rely heavily on Macintoshes, but also utilize IBM compatibles for fast file conversions and batch work. For scanning hand-drawn artwork into their Macs, they (and the other developers in the re-purposed dentist's office) rely on Greg Johnson's (developer of *Toe Jam and Harry*) HP scanner to get hand drawn art into the computer. But what they find they need most, is storage space.

"What we learned most quickly doing this kind of work using graphics and sound, is that gigabyte drives are our friends," says Reiche. In fact, Toys For Bob has four or five of them scattered between the morass of cables and cords under tables that typify any computer-intensive operation.

Along those same lines, another absolutely invaluable piece of equipment for Toys for Bob is a CD-ROM burner, which Reiche has found works well as a back up device. When you're dealing with hundreds and hundreds of hours of work and hundreds of megs of material, a $30 CD blank just doesn't represent much of an expense. "In fact," says Reiche of backup discs, "make two."

"If a game gets done and it's exactly what we set out to do, we probably failed."

It wasn't always this way. Reiche and the Fords were once game developers who did everything themselves. The increasing demand to market more games quickly made that model impractical. With some amusement Reiche talks about how they exhausted themselves with the creation of the original *Star Control*, and decided to do a simple little Monty Python project with lots of video. That turned into *The Horde*, a game in which the bad guys are fat, evil, voracious, and stupid.

For that project, animator Cyrus Lum was hired to develop the Hordeling King. "We said this is how the King should be and this is how everything fits together," Reiche explains. "We didn't sit down and go through every last element of the storyboard. We said, "Cyrus, go."

Reiche doesn't like to put limits on his creative people, and so chooses artists whose styles complement the project so they can be turned loose. As Reiche puts it, "If a game gets done and it's exactly what we set out to do, we probably failed."

Toys for Bob has gone to some unusual lengths to find creative talent. Paul, dissatisfied with the quality of music and sound effects

being developed on cheap soundcards, ran across some samples on the Internet, realized they were what he was looking for, and announced a contest. "I had a budget of about $1,500, ran a contest to create music for *Star Control*, and awarded prizes of like $25, $50, and $100. That's how we got our music." He'd never even met these musicians, who hailed from Germany and Finland. They were very young and they worked on the Amiga, which didn't surprise Reiche. "Have you ever heard of a soundboard for an Amiga? Of course not. It didn't need one. And have manufacturers caught on and given us more than one track to work with on their soundcards? Gravis and the AWE 32 Soundblaster are the only ones," says Reiche. "These guys in Europe just built all these little rinky tink programs to play samples out. They just kept feeding samples, really amazing soundtracks, out into the net just for kicks . I can't imagine these people were any older than 20. Now they just mail me disks. It makes me feel like I'm part of a bigger place."

Reiche is very happy with his working relationship with Crystal Dynamics and with the Ford brothers. "We're just people getting a job done. There are no politics between this group. Once you start having art departments and music departments and this department and that department, the organization gets a life of its own. Instead, we believe in a small command and control structure who are all committed to what we're trying to achieve."

Currently Toys for Bob is deep in the throes of developing a 3DO version of *Star Control II*. Their biggest challenge is dealing with eight hours of spoken audio. They've hired friends and actors to produce hours of conversations for the alien characters. "When I called up union representatives and various studios and asked them how much this was going to cost, they just went crazy. The quotes I got were almost as much as the whole budget for the project, so we had to find a way to do it ourselves."

And they're doing it with the aid of a Mac with an AudioMedia board, a DAT machine, and a mixer. "Now that," says Reiche, "is way cool. For about three or four thousand dollars and a Mac you've got something to make good noise with."

Somewhat bemused, Reiche looks around at all the equipment surrounding him, "This stuff just comes."

Suite Multimedia

Continued from page 58

or premastering phase of production. In either case, you'll need some MIDI gear to generate it and test results. Note too, that your customers also need to have a MIDI sound module with a MIDI interface in their setup to convert the MIDI data into audible music.

MIDI devices can be relatively inexpensive. Soundcards for PCs that are General-MIDI-compatible are both extremely inexpensive and practical. They're utilized by many PC game developers because the General MIDI sound set offers (supposedly) standardized, uniform sounds and effects between machines made by different manufacturers. General MIDI modules and GM soundcards that include audio digitizing capability can be had for as little as $200. Highend equipment, such as professional synthesizers and samplers, can run into tens of thousands of dollars.

The advantage in investing in a modest MIDI studio is that even if you don't include the actual MIDI data on your discs, you can generate an incredible variety of high quality music and sound effects (assuming someone on your team is a musician), not to mention that MIDI data itself takes up very little disc space. Music or sounds generated with MIDI equipment can also be stored in a variety of digital audio formats, including .WAV, Sound Designer II, AIFF, and so on, so it's easy to incorporate with other computer data.

What kinds of gear might you want in a modest desktop MIDI studio? Cyan's Robyn Miller scored *Myst* with nothing more than an E-mu Proteus MPS synthesizer ($1,495) and a Macintosh SE/30 running Passport's Master Tracks Pro sequencing software ($295), a sort of word processor for recording and editing MIDI data.

For your budding MIDI studio, you'll want at least one synthesizer or sound module (anywhere from $200-$5,000+), sequencing software ($50-$900), an audio mixer with enough channels to handle the output of your synthesizers and sound modules ($500-$5,000+), an amplifier and monitor speakers or self-powered speakers ($500 on up), and a quality DAT deck for mastering ($1,100-$2,500). If you feel like getting fancy, include a multitrack recorder (as little as $400 for a multitrack analog cassette deck; digital multitracks run from $2,500-$5,000+; computer-based digital hard disk recorders start at $1,100 not including computer and get into the stratosphere real quick), and sundry peripherals — say, a drum machine, waveform editing software, and signal processors (reverbs, compressors, noise reduction, and so on).

The third audio option, which 95% of CD-ROM developers use, is Yellow Book format audio. This is basically the same as Red Book audio except that the digital signal is stored as standard computer data and played back through software. The advantages are that you can select your own sampling rate (thus somewhat reducing storage requirements), playback sounds while loading other information, manipulate the sound electronically, and interleave audio with video. The disadvantage is your software must handle playback. And that takes processing power. Yes, you can sample your audio at CD-quality rates, but playback will probably strain your system to the limits, reducing its ability to do other things, such as play back full-motion video or display graphics.

To get those sounds, music, or narration into your computer, you'll need an audio digitizer and waveform editing software (see the story on page 46). You'll also have to include audio playback routines in your product's final software. While many Macintoshes come with built-in microphones, it's the last thing you want to use as a digitizer for CD-ROM development. Spend the money. Invest in a good microphone (the choices are myriad) and get a decent soundcard.

For the PC, the latest generation of 16-bit, stereo 44.1kHz cards offer signal-to-noise ratios, distortion specs, and frequency response that are quite respectable at ridiculously low prices.

Our advice: Kill two birds with one stone and get a card that offers both digital recording and a General MIDI soundblock — some cards even come with microphones (possibly good enough for recording speech but not up to reproducing anything where quality is critical), built-in MIDI interfaces (if you buy a card sans interface, be prepared to buy an interface, which will eat up more expansion slot real estate), and tons of useful software — sequencers, waveform editing programs, and even on-board MPEG compression.

A few notables out of a huge field of possibilities (well over 50 at last count): Ensoniq's Soundscape card ($279) is a good all-around soundcard in that it offers good digital audio specs and a good GM sound set. If quality digital audio is your thing, Turtle Beach's Monterey

Suite Multimedia

($399) would be a better choice. The card also comes with great waveform editing software. if you're more interested in the sonic quality of the General MIDI soundset, Roland's Rap-10 ($349) would be our choice. It's based on their famous SoundCanvas, the defacto standard in GM modules. If you already own a Sound Blaster and want to improve its GM sound, a number of companies, including Roland, are building inexpensive GM daughter boards that plug into existing Sound Blasters. If you aren't interested in General MIDI on a card, but want high quality digital audio, Digital Audio Labs' CardD ($795) stands out. It features good audio specs and digital inputs and outputs.

On the Mac, Digidesign's Audio Media II ($1,295) and Sound Designer II ($995) with the Pro Tools audio interface ($5,995) are great if pricey choices. The Spectral Innovations' NuMedia cards ($695 with digital I/O; $495 without) offer an alternative for those on tight budgets. The Digidesign cards are defacto standards in Macland digital audio, and offer direct access to high-quality waveform editing and extensive DSP functions (sophisticated equalization to noise reduction to sample-rate and bit-resolution conversions) for manipulating your audio. Of course, if your development platform is one of Apple's AV machines, you might have built-in digital audio (not to mention on-board DSP and video capture) capabilities already.

For GM sound development on the Mac, you'll need a stand-alone General MIDI module, such as one of the Roland SoundCanvas SC-88 series (starting at $1,095), Yamaha's TG300 ($895), and Korg's 05R/W ($799), all of which include built-in MIDI interfaces. Naturally, GM modules can also be used in PC systems.

Images. Unless you're making a simple data CD-ROM, you're going to want to add pictures to your product. There are numerous ways to get still graphics into your system: Create them with a paint program or modeling software, scan them, digitize them with a video camera, use clip art, or have your custom program generate them itself.

Flatbed scanners are good for converting flat artwork, charts, and photographs into digital information that can be manipulated in the computer, while video digitizers can be used to grab a single screen or series of screens from a video source, such as a camcorder or video deck. Scanners produce very high quality images from flat material — it's even possible to scan surfaces of 3-dimensional objects, though some tweaking with photo manipulation software such as Adobe's PhotoShop may be needed to obtain good results.

We recommend getting the best scanner you can afford up front. A couple suggestions: The Hewlett-Packard ScanJet IIcx (around $1,100) is bundled with Aldus PhotoStyler SE software, provides a top resolution of 400x800 pixels, and can do 24-bit RGB color scans in a single pass; Umax' UC630 LE ($999) offers a maximum resolution of 1,200x1,200 pixels, and will do 24-bit color scans (it takes three passes to do RGB scans). Both units offer optional attachments for scanning transparencies (add $500+). A not so obvious, but practical alternative: Take your images to be scanned onto a Kodak Photo CD. It'll cost you three bucks per image, but you'll have the image in digital form at a variety of resolutions, the max being a whopping 2000x2000-pixel image. Several CD-ROM drive manufacturers bundle software utilities that allow their machines to read Photo CDs.

> You'll want a fancy schmancy video board to bring images into your computer for editing . . .

Video digitizers, a.k.a. video capture boards a.k.a. frame grabbers, are more flexible in what they can capture, but are limited to the resolution of the incoming video from a camera, video tape, or video disk. They may also require additional lighting, tripods, and expertise. An ideal setup would include both a scanner and a video digitizer, but if you can only afford one, a digitizer can substitute as a scanner, while the reverse isn't necessarily true. Capture boards allow you to store images in a variety of file formats (TIFF, PICT, EPS, PostScript, and so on) so they can be manipulated in programs such as PhotoShop, come in a variety of flavors from 8-bit-gray-scale capture to 24-bit color, and can often grab both single images and continuous frames — otherwise known as . . .

Video. The line between professional video and desktop video production, like pro audio and desktop audio production, is constantly blurring. Professional desktop editing systems, such as the Avid, are used in broadcast television as well as multimedia development. Luckily, you won't need to invest in a zillion dollar professional system to do multimedia video — unless you want to. But brace yourself, the land of video is thick with complexity.

Just like your suite's computers, you'll want a fancy schmanzy video board to bring images into your computer for editing, but you'll need a base-level consumer board to view what your customers are likely to see when they view your application.

Video cards come in three basic flavors: "Video in a Window," "Still Capture," and "Motion Video Capture" cards. Video in a Window cards primarily display television signals on your computer monitor, but won't necessarily allow you to store it in memory. Still Capture cards will grab single frames but not necessarily full-motion video. And Motion Video cards will capture images sequentially at a frame rate high enough to simulate motion. As mentioned above, many cards combine two or three of these tasks, blurring the lines between functions and nomenclature (which is probably why there are so many names — digitizers, capture boards, frame grabbers, blah, blah, blah — for video cards).

What card you choose as a development tool will depend on the nature and quality of the images you want to work with — 8-bit resolution is typical for multimedia, 16-bit res for NTSC video (what you get on your TV set), and 24-bit for highend graphics. Most people start with high res images and adjust the output down as needed. You'll also want to pay attention to image size and frame rates. Why? Because cards are often limited in those areas and with reason: If your intended application is a CD-ROM game, you probably won't want to go anywhere near full-screen images running at 30 frames per second (fps), because the larger the image, the slower it will run and the more disc space it will eat up. Whereas if you've got aspirations of doing broadcast quality video work that you want to re-purpose in an infortainment product to be delivered on CD-ROM, you're talking about going for a video board that will allow you to work in NTSC-format (PAL if you're doing European video, SECAM in France).

Another important consideration: Video input and video output are two separate an-

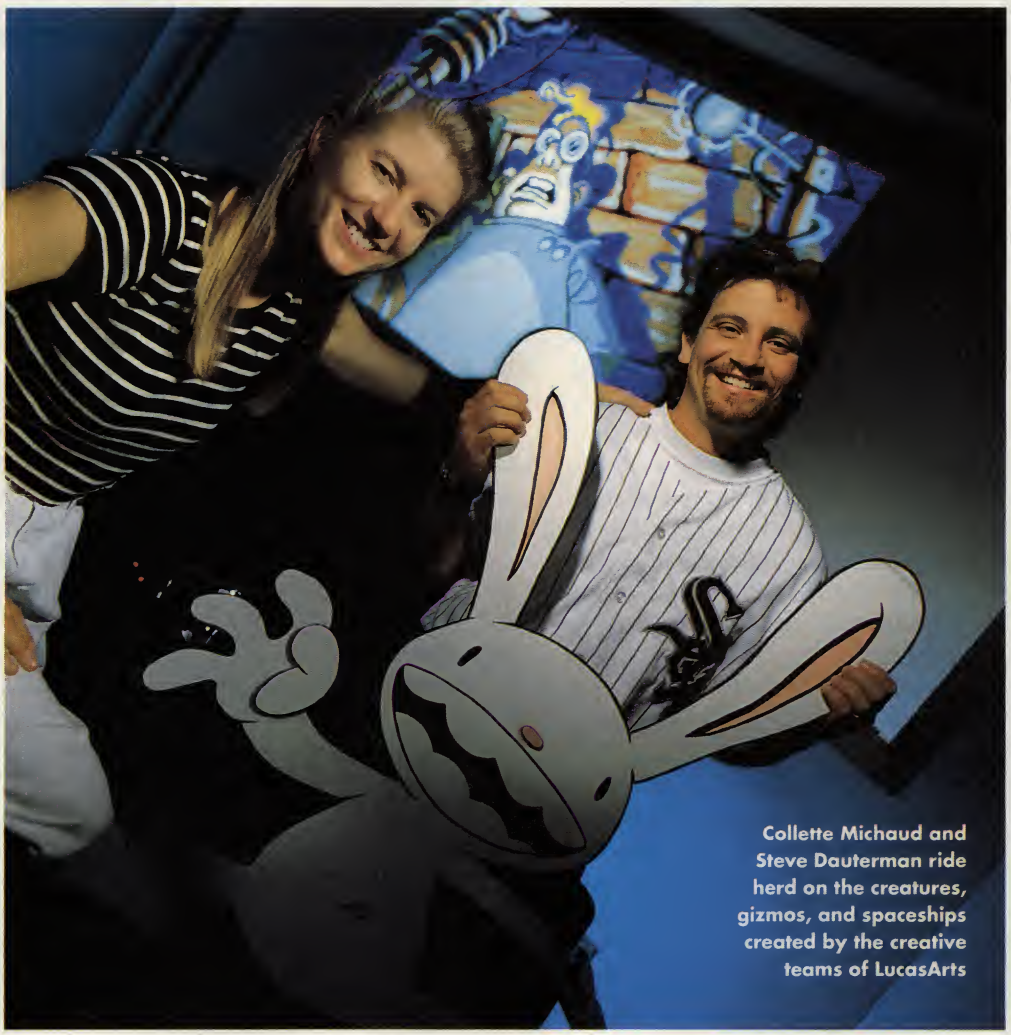
Continued on page 65

LucasArts

PUTTING CUSTOM TOOLS TO WORK

BY KATHLEEN MAHER

A compound of stucco buildings sits just off the main drag in San Rafael, California. They're not particularly noteworthy, but in these structures are fighter jets, star troopers, motorcycle riding cartoon characters, cartoonists, animators, 3D artists, musicians — an army of creative people and their creations. These buildings are skunk works and it doesn't do to call too much attention to your business when the competitive heat is turned up as high as it is in the game business and the company in question happens to be LucasArts, the game division of George Lucas' entertainment technology empire. ■ Collette Michaud



Collette Michaud and Steve Dauterman ride herd on the creatures, gizmos, and spaceships created by the creative teams of LucasArts

PHOTO: GARY LAUFMAN

LucasArts

has the enviable job of art director at LucasArts. Over the past few years, she's been building a stable of creative people who can take on any task handed them. At present, about 30 staffers are involved in generating art for LucasArts, including 3D artists, animators, and illustrators, as well as one architectural designer and a couple of industrial designers.

"I bring people in pretty young," says Michaud, "right out of school. Artists I can train. Technology is changing so fast they learn as they go. Every product is constantly changing, so to go out and try and find artists that you need for every project is a time-consuming process."

Steve Dauterman, a LucasArts project manager, agrees. "It's difficult to find really solid contract people who can come in and work for just a few months. Also, there's just so much ramp up time involved."

But the main advantage, both Dauterman and Michaud agree, is R&D and training is part of everyone's job description. And downtime between projects is considered time to devote to training and R&D, factors they consider crucial to success. "I really look to invest in artists over a long period of time." Michaud adds.

Consider. Just last year the Top 10 list of best sellers was fairly stable. Titles such as *7th Guest*, *Cinemania*, *Rebel Assault*, to name a few, hit the list and stayed there. But the game charts are beginning to resemble the pop music charts, with a new lineup being issued every month by yet another multimedia market analyst or insider report. This market is not standing still. It's a market that depends on young, male consumers — not a group noted for long attention spans. Games have to be flashy, loud, fast, and new. And the technology to develop those new games is evolving as fast as the games themselves.

Given the fast pace of innovation it almost doesn't matter whether creative people come to the job with the necessary computer skills, because they can learn them. Michaud's emphasis, as is the emphasis in most game development houses these days, is on talent rather than technical skill. However, Michaud is finding the task of locating artists with computer skills much easier.

Sophisticated computer art is not only becoming easier to create, it's also becoming cheaper. More schools are teaching computer graphics, but just as importantly students are often learning their craft on machines and software they can afford to buy when they get out of school. Michaud also finds herself hiring more self-taught artists.

> Most of the art, sound, and animation for LucasArts is created on humble 486s . . . Why? "Target audience."

"The tools being used to create games are proliferating," says Michaud. "Over the past few years we have favored a few products. Deluxe Paint by EA has been a standard for animation as well as background art. That is changing though. The tools available have continued to evolve to the point where now we use a lot of other products, including Photoshop, Premiere to do the video, 3D Studio, Prism (on the SGI), AutoDesk Animator."

Tool Talk

When it comes to putting it all together, LucasArts relies on its own authoring systems — another advantage of keeping development staff in house. The first permutation of that authoring system was called SCUMM (Script Utility for Maniac Mansion). It was further refined in the creation of *Rebel Assault*. That refinement continues.

Surprisingly, most of the art, sound, and animation for LucasArts is created on humble 486s (with tons of ram and storage space).

"Unlike many other developers," says Michaud, "we're primarily a PC house. Some of the video gets done on Macintoshes. There are a few SGI workstations involved, but most of the work is done on 486s and a few Pentiums." Why? "Target audience," snaps Dauterman with a smile that says this should be obvious.

Let's not forget, however, that LucasArts has resources. Lots of resources and they're using those to push the envelope, trying to redefine what games can be. As Dauterman points out, "We have the luxury of having Industrial Light and Magic next door.

"Right now," says Dauterman, "characters tend to be aliens, dinosaurs, ghosts, because real human characters are difficult." The challenge for all 3D characters — animal, alien, or ectoplasmic — is basically the same. As Dauterman says, "It's not as hard to build a 3D character as it is to get good motion. We do a 3D character in *Rebel Assault*. It was our first attempt at it and you'll see more in our next product."

A great deal of R&D effort is going into incorporating video into game titles. According to Michaud and Dauterman, video has not been used to its full potential but it has been overused. "Video is non-interactive," points out Dauterman. However, both Michaud and Dauterman feel video can be used effectively to set up the action as is done in *Rebel Assault*.

2D for 3D and Back Again

Michaud believes the trick is to put it all together so seamlessly that the viewer isn't

conscious of the transition between 2D, 3D, and video. And she's proud of the work done on their newest titles, *Full Throttle* and *Dark Forces*.

In *Full Throttle*, a continuation of the series that includes *Day of the Tentacle* and *Sam and Max Hit the Road*, the development team created an illustrative look. The typical 3D model doesn't fit into this background, but the story calls for elements that are difficult to create and use in 2D. "Like motorcycles," says Dauterman, "and hovercraft," adds Michaud. "What we're doing is building these models and we're applying a lot of flat shading to them to make them fit into the backgrounds we've created." Once created, one model can be used over and over, front view, side, and so on.

Dark Forces is a continuation of the *Star Wars* series complete with storm troopers. In this case, the storm troopers are 2D characters shaded and drawn so they look 3D to fit in the world they inhabit. To heighten the effect the development teams incorporated more cinematic effects using traditional filmic techniques such as closeups, cutaways, and very fast edits to establish an emotional response to the characters and to generate excitement.

Sound plays an important role in heightening the cinematic aspects as well and is one of the areas LucasArts feels they have made the most advances thanks to the wide acceptance of the CD-ROM as the medium for computer games. Developers now have 650 megabytes of space to work with. Games, because of the multiple threads of action, can have many more lines of dialog than a movie. LucasArts hires professional actors to record dialog in sound studios. The result, they feel, has profoundly affected the way people interact with their games.

"We've gone from silents to talkies in a big way," says Dauterman. "Once you play a game like that, you just don't want to go back to reading dialog on the screen."

In the area of audio, LucasArts again relies on their own tools. Their system for handling music is called IMUSE (Interactive MUsic and Sound Effects). It coordinates the action on the screen and the corresponding soundtrack, allowing changes in the scene and in music to happen more seamlessly with transitions. The programmers at LucasArts are tinkering with IMUSE to better handle sound and take advantage of new technology that finally gives them the ability to have multiple tracks of sound. "In *Tie Fighter*, we have multiple sound effects going along with the music. You have somebody speaking to you while you're firing your laser. That's really impressive." Right now LucasArts is using four digital tracks, but they plan to expand it to eight.

Organization

All this talk of cinema makes perfect sense when talking about LucasArts. After all, they were spawned by the film industry and the organization of the company follows the classic Hollywood studio model.

Game ideas are usually developed by team leaders, though proposals can be submitted by anyone. These ideas are then submitted to a board, which further refines the them. Michaud and Dauterman put together the teams to go to work on a project that has been given the green light. "Normally, " says Michaud, breaking down the process, "we have a project leader and a programmer, a lead artist, and a lead animator. The project leader writes the design, and with the help of the lead artist and the lead programmer (who might also be the project leader), they go into story boarding, fleshing out the design and character development. That part takes anywhere from two to four months. Then we bring on a full team, which usually consists of anywhere between five and nine artists." Additional elements, such as sound, are defined as external services. Teams usually stay together for about 12 to 14 months.

"The advantage of working this way," Dauterman explains, "is that the team forms a really tight group." He believes their commitment to the project is evident in the work they produce.

It seems fair to say that LucasArts uses this model because they can. They've got the money, they've got the infrastructure, and they've got the talent. There is a sense here that control is everything. Obviously, there has to be creativity or the games would be dull, yet the parallels to the early days of the film industry with strong studio systems to the present with fluid groups of independent producers is inescapable and points up the obvious. Games are not only big business, they've become an industry to rival that of film.

Suite Multimedia

Continued from page 62

imals. Just because a board can capture video, doesn't mean it will allow you to record its output on video tape or display it on anything other than a computer monitor. If you want to deliver or archive your edited video footage on video tape, you'll want a video output card that supports NTSC.

Like soundcards, the number of video cards to choose from is huge. A few lowend standouts: On the Macintosh, SuperMac's VideoSpigot ($279) will comfortably capture 320x240 frames sizes at 15 fps, and features a composite video out compatible with the RCA jacks on most VCRs, and come with Adobe's Premiere editing software. MovieMovie ($349, $449 w/DiVA VideoShop) from Sigma Designs will capture both audio and still images or full-motion images up to 640x480 frame sizes. VideoSpigot Pro ($1,999) also includes Adobe's Premiere editing software, supports 24-bit color on 12" and 13" displays, and features graphics accelleration. And on the high-end, the Radius VideoVision Studio ($4,995 w/software, $3,995 w/o) will capture full-screen 24-bit 640x480 frame sizes at 30 fps, supports both composite and S-video connectors used on highend consumer S-VHS and Hi-8 video equipment, and supports machine control, SMPTE time code synchronization, extensive video special effects, A/B roll editing, and is available with Premiere 2.0 and VideoFusion editing software. Advanced Digital Magic markets a no-excuses pro quality 60 fps, Beta SP or D1 compatible digital video recording system called Digital Magic ($7,995+). It comes with MacVAC that sequences and composites 2D and 3D animation files. The system will output QuickTime, PICT, Electric Image, Targa, 3D Studio, and SGI file formats, and includes compatibility with 16-bit audio boards. Another option: Interface with pro production houses via some hardware and software such as ASDG's Abekas Driver ($495), which enables users to single frame grab in D1 video format and bulk transfer full-motion NTSC or PAL video.

On the PCworld's lowend, there' s a wide variety of products available for video capture including Orchid's Videola ($399) and Diamond's VideoStar Pro ($359), which are quite competant at capturing video at 160x120, 15

Suite Multimedia

fps. Likewise, the VideoSpigot for Windows ($299), represents a lowend option. Even at this price range there are boards that promise full-motion image capture, compression, and playback; VGA pass-through; NTSC, PAL, SECAM, and S-Video inputs, but the quality of video is going to vary and you can expect drop-outs and artifacts.

The price performance ratio should improve this is the year, as we begin to see video make a splash in the consumer market thanks to S3's new 928 video accelerator, which promises full-screen Video for Windows clips. The first out is VideoLogic's 928Movie ($349). The VideoLogic is also significant, because it makes use of the VESA Media Channel interface, which will let users connect a 928Movie to another multimedia board, such as a video capture, overlay, or MPEG compression board installed on the same system. S3's line of graphics processors has been successful in bringing high resolutions to the desktop and there's no reason to suspect their video accelerators won't do the same. Keep in mind, if you're creating a CD-ROM for the consumer market, the average capability is going to be 160x120, 15 fps, for now. But advances are happening so quickly that planning for a full screen video future is the only path that makes sense.

On the highend, Truevision is the veteran in the field and, along with Matrox offer highend video capture and post production systems, which range in price from around $10,000-$27,000. However, both TrueVision and Matrox also offer products capable of capturing full screen 640x480 video at 60 fps per second and output to NTSC at the midrange as well. The Matrox Animation Express (MAX) sells for $5,995 and Truevision's Targa 2000 is also $5,995. Both boards offer utilities to output animations direct to videotape in a manner that won't trash a single-frame animation recorder. In that arena, the system that's getting all the attention, though, is the DPS Personal Animation Recorder (PAR), a hardware and software system that delivers NTSC output and is winning hearts out in the field. The advantage to DPS's hardware/software approach is that the software is optimized for the hardware and DPS's hardware preproccessing takes the load off the CPU so the computer's processor is less of an issue. DPS has also released a video capture board to work with the system, the TBC IV ($995).

As for editing software, most of the boards mentioned here ship with their own software or with Adobe Premiere or Video for Windows. Be sure and consider editing software along with a board and make sure that if it doesn't come with software, that it has drivers to support the program you buy separately.

Software. So many choices, so little space to write about them

There aren't any rules here. And there's no master list of products you must own to gain certification by the Grand High Poobahs of Multimedia. But there are some basic core products you'll want to have around.

Authoring Systems. These are covered indepth elsewhere in this issue (see the Step-By-Step Guide to CD-ROM Production Basics, page 72). In brief, if your project involves more than simply putting mass quantities of data files out via CD-ROM, and requires that data, text, graphics, audio, and video be intermixed, you'll want an authoring system capable of handling that task (see page 90 for a partial listing of the myriad options available).

Graphics. Depending on how many and what sorts of graphics you intend to include on disc, the types and varieties of graphic software are almost limitless. Paint, rendering, CAD, business graphics, clip-art, font, 3D, animation, image conversion, image processing, and on and on. Even if you don't intend to actually create the images yourself, you'll find that you'll want some software onhand that allows you to view and perhaps manipulate images after they're delivered to you. Our advice: Stick with software you're familiar with, and branch out when you encounter problems or tasks your current software can't handle.

On the PC side: The Windows Paintbrush applet included with the Windows operating system, while limited, can be used to generate quick, simple graphics. Corel PhotoPaint, Harvard Graphics from Software Publishing, Micrografx Windows Draw!, or Electronic Arts Deluxe Paint are all good paint programs that can be used not only for graphics but for generating text screens, converting image formats, and many image processing tasks. And Adobe's PhotoShop ($895; is there a platform it's not available on?) has become a defacto standard in image manipulation.

On the Mac side: Photoshop ($895) is a must. Fractal Design Painter ($399), Adobe Illustrator ($595), and Aldus Freehand ($595) are all invaluable for generating compelling images.

For rendering, animation, and 3D graphics, the universe of available products is gargantuan. A few standouts on the PC: Autodesk 3D Studio ($2,995) and Animator ($795), Corel Draw! ($695-$1,195). On the Mac: StrataVision 3D ($995), Alias Sketch ($695), Macromedia Swivel 3D Pro ($695). . . . Whatever programs you choose, make sure that they support file formats that are compatible with your authoring tools, and *vis versa*, though if they don't you'll want one of the many format conversion utilities available.

Raw full-motion video is voracious in its need for memory, you'll need some kind of compression technology — the most common schemes in multimedia being QuickTime and Video for Windows. For full 30 fps desktop video, most people rely on hardware-assisted JPEG (Joint Photographers Expert Group) compression. Highend systems use much more costly, but much higher quality, MPEG (Motion Picture Group) compression. But one thing about video boards and compression algorithms: It's impossible to judge quality based on fancy acronyms and multi-digit bit resolution specs, especially when compression is being used, because different compression algorithms can yield wildly different results. Sometimes, you can only spot the difference by looking at second- or third-generation output.

When all that's said and done, you'll need a video camera and a tape deck or two. Virtually any camera will work, but the higher the quality camera, the better your results will be. Your best bets: Hi-8 and S-VHS cameras — for as little as $2,500, you get very respectable image quality. If that seems high-priced, consider that professional Betacam cameras start at $6,500 and get up to $16,000+. As for tape decks, you'll want at least one VHS machine, because everybody has them and if you intend to send tapes around, it's a good format for demos. Your other choices will depend on your camera's format. One tip: Hunt for used machines. Pro production houses are always unloading their older gear, and it can often be had ridiculously cheap (we recently picked up a 3/4" pro deck for $200).

But wait, there's more. If you're planning on integrating video with audi or MIDI (that's what multimedia is, isn't it?) you'll need to be concerned with synchronization. QuickTime 2.0 automatically syncs audio and video. Some video boards have onboard support SMPTE (Society of Motion Picture and Television Engineers) sync. Others require external sync boxes. And some systems, such as the Avid and Digidesign's Pro Tools use proprietary techniques. The good news: A number of music software houses market relatively inexpensive MIDI interfaces that support SMPTE, among them Mark of the Unicorn (Video Time Piece, $1,195), Opcode (Studio series from $320 to $1,195; Translator ProSync $249), and Music Quest (MQX-32 $250).

The Big Bottom Line. So where does all that leave you? Whether you're running for cover or diving in head first, the important thing to realize is the real cost of doing multimedia development is in personnel and time. There are no all-inclusive sources of information on CD-ROM development — the industry is still busy inventing itself along with the paradigms of successful, compelling interactivity. You'll have to buy all the gear, read all the manuals, search out people in the know, and expect to wrestle with system incompatibilities. And make a bunch of mistakes of your own along the way. After all, if multimedia development were easy, everyone would already be doing it. And the rest of us would be looking into setting up Virtual Reality development suites.

software for MIDI data) to editor/librarians (which allow you to alter and store to disk synthesizer sounds) to digital waveform editing software (see the Guide to Graphic Waveform editing story on page 46), to hybrid MIDI sequencing/digital recording systems, the number and type of music software available is outrageously huge.

As with graphics applications, even if you're contracting your soundtracks to freelance musicians, you may want to have a compatible sequencer on hand to play back and do minor edits to their work.

A few notable sequencers: In Macland, Opcode Vision ($495), MOTU Performer ($495), Steinberg Cubase ($349), and E-magic Notator Logic ($399) are highly popular choices, as are their digital audio recording meet MIDI counter parts, Studio Vision Pro ($995), Digital Performer ($895), Cubase Audio ($799), and Logic Audio ($699). Another good choice multimedia development tool: OSC Deck II ($399), which supports QuickTime as do the latest versions of Logic Audio and Studio Vision AV. Similar support is planned in Digital Performer and Cubase Audio.

In PCland, the most popular sequencers include Twelve Tone Cakewalk Pro 3.0 ($349), PG Music PowerTracks Pro ($29!), and Passport Master Tracks Pro (ported from the Mac). Most Windows sequencers support triggering of .WAV files, so when married to a soundcard they mimic the function of sequencer/digital audio hybrids.

Premastering. You can send raw, unformatted data to a duplication house and have them format everything for you and they will charge you for this. Or you can format your data into ISO 9660 (or HFS, UNIX, or whatever) yourself and to do that you will need formatting software. Many formatting packages on the market provide simple point and click front-ends and handle everything else automatically. Other packages allow emulation, manipulation of the file structure and provide other bells and whistles. If you are planning to do more than one disc then you might want to purchase your own formatting software (see the CD-ROM production basics story on page 72 for more details and a listing of formatting as well as search engine software).

Miscellaneous. Any software development house will tell you that they use dozens of different software packages that directly affect their final products. There are also a handful of other packages that make the development cycle smoother or more efficient — word processors, spreadsheets, databases, networking software, file managers, and all the other utilities you're likely to find in a business computing environment.

3D STUDIO POWER TOOLS

MAKING SHADOWS • MAXIMIZING MEMORY • MINIMIZING HEADACHES

BY KARL RAADE

One of the biggest problems with being an animator these days is just how much you have to know and keep track of in order to get the job done. You have to be animator, artist, sculptor, director, lighting technician, cinematographer, camera operator, videographer, choreographer, editor, set designer & dresser, prop manager, and technical advisor. And if your animation is product specific, you may have to become an expert on the product's structure, requirements, construction process, function, operation, and so on.

To make the your job a little easier, I've put together the following tips that can make the technical aspects of working in 3D with Autodesk's 3D Studio a little easier. However, my first tips address something can't be solved by clicking an icon or choosing an option.

Input In

An art director who truly understands what an animator does is extremely rare. Sometimes art directors bring you a storyboard and concept, knowing exactly what they want and will actually tell you what that is. More often, however, it's a completely different case. The art director has no idea how you do what you do, but insists on telling you how to do it. Once you wrestle an idea or a concept from the AD it's up to you to make it work however possible. Nevertheless ADs will always, regardless of the results, make changes to your work. Every animator or digital artist works with one of these people at some point or other.

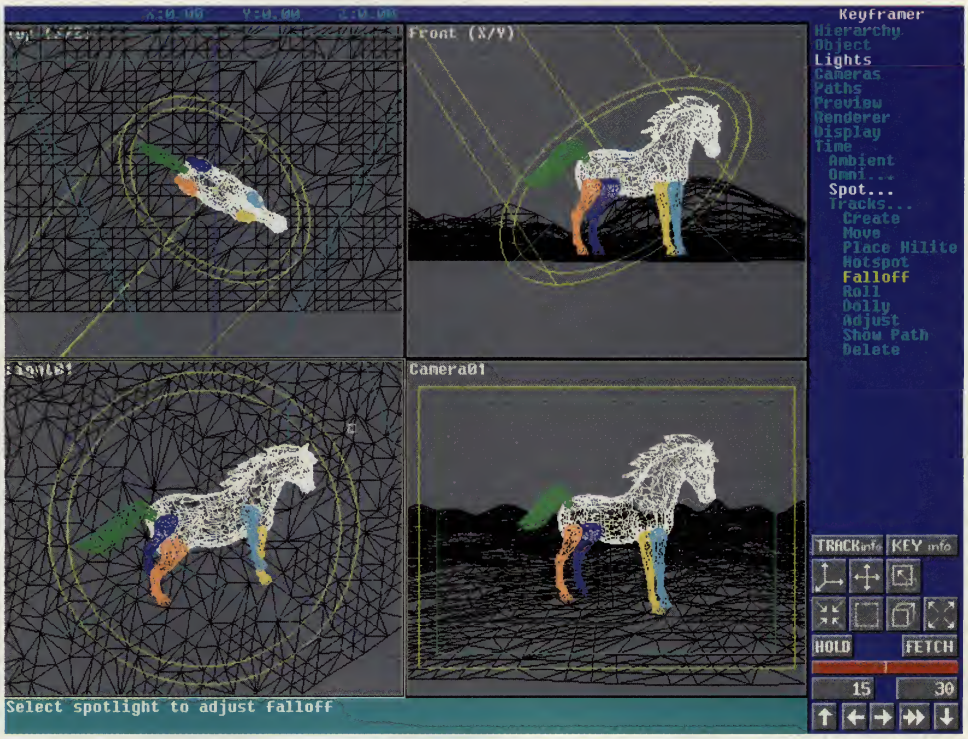
For those encounters, I have one important tip: Bring the art director in for inspection just before the animation is finished. Show him the work so far and tell him what you plan on doing towards finishing the project. Then, ask him what he thinks, complete with choices. These should not really be choices of any real weight. They may be choices that are all the same intended course of action, just worded in different technical ways. You could give him choices of different paths of movement, camera views, or materials. For the art director who really does not understand the software and the process involved, that may be enough, and frequently they'll agree with you emphatically. Almost all art directors need to feel as though they're making the majority of the decisions for the piece, and you need to be aware they feel that way. It may be manipulative, but sometimes it's a necessary part of getting the project finished.

Karl Raade is a staff artist and animator with Autodesk.

Inspiration In

One of the most important pieces of equipment to keep nearby is a VCR. A VCR can be the best way to get source footage for your animation. Whether it's a knee implant or a cotton gin, if you can't study a model on your desk then take a camcorder and get all of the reference material you can. Too much reference material is always better than not enough.

Also, use the VCR to bombard yourself with cartoons. If you have nothing to study on the tube or if you aren't using your frame buffer right then, you should have *Koko the Clown* or *The*



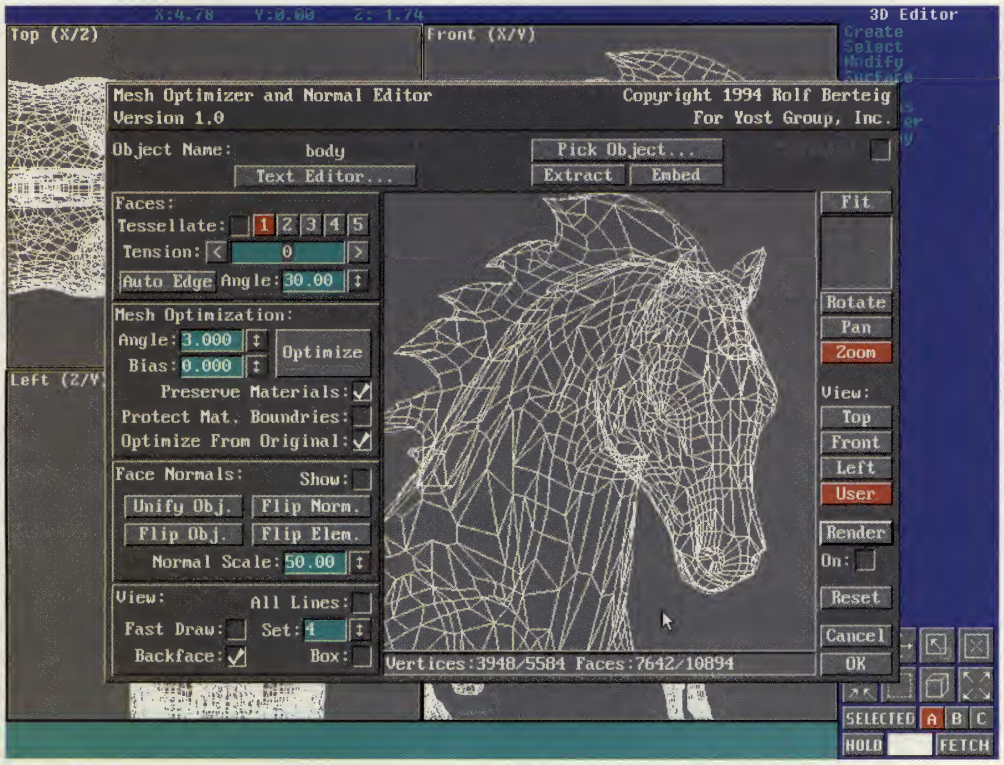
1. It's a simple matter to view an object through the spotlight. Simply select the viewport and press $ for spotlight view.

Brothers Quay or *The Wizard of Speed and Time* playing. Not only is there an incredible amount to learn about aesthetics, style, structure, composition, movement, color, story-telling, *et al.*, but if hours upon hours of cartoons and animation become too much for you, then the wonderful world of computer animation just *might* not be the right vocation for you.

Shadow Works

Shadows are an effect that sometimes mean the difference between a shot appearing "real" or looking computer generated. Though if you can live without them for the duration of a shot, you can cut your render time drastically. There are many ways to set up your shadows, and generally speaking shadow quality and accuracy will cost you considerably in render time.

One method for making the most of your shadows is to use OVERSHOOT. Suppose you have



2. Optimize allows you to reduce the number of vertices and faces in an image with a negligible effect on the geometry.

a single figure walking through a rough, though relatively flat landscape. Here the shadow is needed in only a small area, yet you need to illuminate a large area without using multiple lights. First, aim the spotlight at the figure and link the spotlight's target to it so it can follow the figure's path. Next, choke down the hotspot and falloff until they just cover the figure through the duration of the shot (viewing through the spotlight makes this incredibly easy to do; as shown in Fig.1, just select the viewport and press $ for SPOTLIGHT VIEW). Now turn on the OVERSHOOT feature. The entire scene will be illuminated without having to pump up the size of the shadow map.

But what if the figure is flying overhead? You may be able to render a silhouette of the figure for use as a projector. To do this, just HOLD your place and adjust the spotlight and target as described before. Now, turn the figure flat black, render it against a white background, FETCH back to where you were, and use the image you just rendered as a filter for a projector light. Add an OMNI LIGHT at or near the spotlight and exclude all but the figure from it. Exclude the figure from the spotlight so there will be no "shadow" on it. You'll still want the light's target to follow the figure as it did before and you may wish to use OVERSHOOT, but now you have a simulated shadow. It's important to have a test render of this to be certain that the shadow maintains the correct orientation. If the figure rotates or has a lot of movement you might end up with a shadow that has a mind of its own.

Sometimes you don't even need to use a shadow. If the figure is at a higher altitude, the shadow will become less defined. In this case you can put an OMNI LIGHT in place of the sunlight, and link the spotlight target to the figure as you did before. Now choke the spotlight's hotspot down all the way and adjust the falloff to something close to the size of the figure. Now, add a negative value for its MULTIPLIER value, and exclude all but the ground. What you have now is a spotlight that actually removes light from its cone of influence. This works great but will not remove all light from a given area, since it will have no effect on the ambient light. For simple simulated shadows this will render relatively quickly. NEGATIVE LIGHTS can be fun for different effects as well, so they are well worth playing with just to get a feel for what's possible.

Fig. 3a

Fig. 3b

Optimize Is Your Friend

Consider these three possibilities: You have an incredibly detailed animation, but you don't need a lot of detail in every shot; you'd like to simplify geometry you already have to create a new animation; or, you're faced with lofting an object using a lot of steps, but only one area really needs to be highly detailed. Just select the faces that are too detailed and load up OPTIMIZE (see Fig. 2). Now you can cut down your vertice and face count by a little or a lot, depending on the angles between the faces or how many faces you select (the button in the upper right of the user interface allows you to affect only selected faces in a particular object). This trick is especially useful when you're using

Fig. 3c

Fig. 3d

Fig. 3. When possible simulate your shadows to cut down rendering time. To get an idea of the difference simulated shadows can make, look at these four images. 3a has ray-traced shadows, and took 682 seconds. 3b was rendered with a shadow map (map size=300) and took 403 seconds. 3c has its shadow simulated by the use of a projector light, and took 233 seconds. 3d also has a simulated shadow, this one being made by using a spotlight with a negative multiplier, and took only 188 seconds.

prefab or scanned geometry. Also, if you prefer the freeform method for building your models, OPTIMIZE is handy for getting a quick look at geometry in progress. It's worth playing with for a little while to get a feel for the affect it has on certain angles and how to select just the faces to affect. You wouldn't, for example, want to use OPTIMIZE on geometry that is already involved in a morph, but it's easy to get hooked on this feature and use it on nearly all of your geometry. After the first few times you've cut your face count in half, OPTIMIZE could well become your best friend.

Keeping Track of Limbs

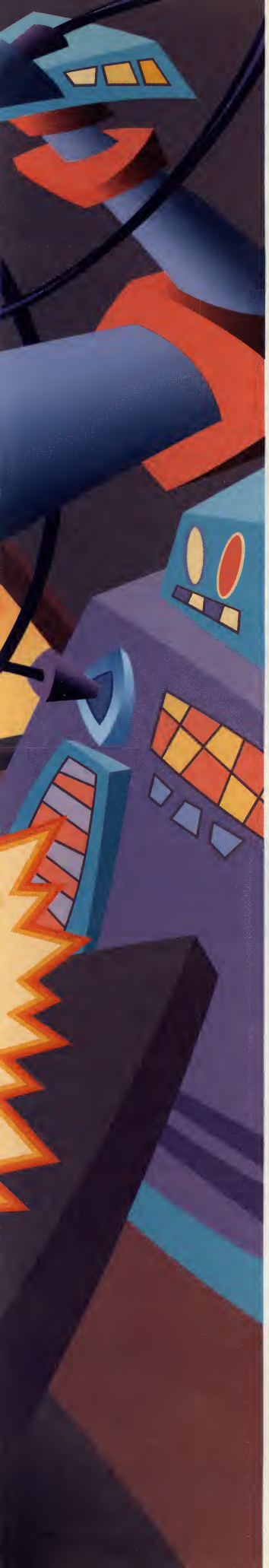
Whenever I'm working with a figure (be it human, robot, llama, whatever) or anything symmetrical enough that the left and right can become easily confused when viewed as a wireframe from certain angles, I color code each limb. Usually I use a dark blue for the left leg and cyan for the left arm, orange on the right leg and yellow on the right arm. Cooler colors on the left, warmer on the right. Or use primary colors, darks and lights. Whatever. Just stay clear of anything close to red because you can get confused when you start using SELECTION SETS. This way, whenever you're editing the MOVEMENT KEYS from the side, you'll always know which limb you're adjusting.

Smooth Sailing or Roughing It

If a path needs to be smooth but is getting jumpy from continuous adjustments, try linking the source of your path (geometry or camera or light) to a series of three of four dummy objects. Now rebuild your path using movement from only these dummy objects, allowing one to move or rotate for each axis. Liberal use of EASE-IN and EASE-OUT can often make the entire movement much easier to control, especially if the desired movement is intended to be steady-cam smooth.

Conversely, in the real world, there's no environment where everything is absolutely clean, smooth, straight, and fits together correctly. These little imperfections can be hard to duplicate, but they add a realism. If you're hanging wallpaper, make a bump map that adds a few subtle bubbles or ripples. Slightly bend fence posts and trees and other things that are trying to be absolutely vertical. One way to add dirt or texture is with a speckled map that can be blurred and used to slightly filter your maps. Sometimes you can do this best by adding the imperfections to the maps from the beginning. At any rate, be subtle with it.

Another trick to simulating the real world is by adjusting the chroma on your texture maps. Often, no matter how careful you are with a picture or video capture, the saturation of the image will become exaggerated. When this happens, adjust the settings on the texture map. Select RGB TINT and drop the saturation on each color down just a little bit to 220 or even 200. It's a subtle change, but it can help a lot.



BURNING DOWN THE HOUSE

BY GUY WRIGHT

A STEP-BY-STEP GUIDE TO PRE-MASTERING YOUR OWN CD-ROMS

IF you are already producing CD-ROM discs (or about to) then you may have wondered about the possibility of burning your own pre-masters rather than sending out tapes and paying $100-$200 to some outside company. Compared to just a few years ago, CDR (Compact Disc Recorder) units are available at very reasonable prices these days (from $2,500-$10,000+), and it seems like everybody is offering CDR services. But exactly how

ILLUSTRATION: ROBERT BURGER

BURNING DOWN THE HOUSE

do these devices work? And when it gets down to those last few technical details what do you have to know to burn your own?

Before you plunk down the money, roll up your sleeves, and start burning discs, it'd be wise to review the entire CDR process, start to finish.

Standard Issues

Keep in mind that a CD-ROM drive can be treated much the same as any another 654.7MB hard disk drive on the system, except that it has a few peculiarities. It is Read-Only. It will be very slow compared to a traditional hard disk drive (about one tenth the speed), and the file format is either HFS (for Macintosh) or ISO 9660 (for PCs or Macs). There are other formats, such as CD-XA, multisession, and proprietary formats, but unless you have a specific need to use one of these formats you should stick to HFS or ISO.

The ISO 9660 standard is the primary CD-ROM standard in the industry for computer data. It specifies how files are laid out on a disc, what the directory structure is, and the level of error checking. Mode 1 discs have three layers of error detection and correction (used mainly for computer data). Mode 2 discs have two layers of error detection and correction. Mode 2 is used mainly for audio or compressed audio/video where an occasional missing byte won't make that much difference during playback. CD-XA (used by the Philips CD-I player) is a mixture of Modes 1 and 2, and is sometimes called a bridge format. ISO insures that any ISO-format CD-ROM disc will be readable by any CD-ROM drive (even if the information is gibberish to the system reading it — the PowerPC not withstanding, Mac's still can't run DOS programs and vice versa).

When you get into the CD-ROM production world you'll also hear terms such as Red Book (for audio), Green Book or bridge (for CD-I CD-ROMs), Orange Book or Frankfurt Group (for CDR), High Sierra (early ISO 9660), and Yellow Book (current ISO 9660) [see the accompanying glossary for a full explanation of CD-ROM terminology].

You don't really need to understand the ISO 9660 standard inside and out before burning a disc, but there are a few things about ISO that you must know even if you plan to send your title to a CDR service for burning.

Files and directory names can only contain the numbers 0 through 9, capital letters A through Z, and the underscore character (no dashes, spaces, etc.). File names may only be eight characters long, followed by a period and a three-character extension (for example, 12345678.ABC). Directory names can only have eight characters (no extensions). Also, when designing your directory tree structure you may only go eight levels deep.

Most CD premastering software will filter file and directory names automatically for you, but it's a better idea to get used to using ISO guidelines when developing your project in the first place so there are no surprises later on. Also keep in mind that while some premastering software allows you to position files and/or directories where you would like them to appear on the CD-

COMING TO TERMS WITH TERMINOLOGY

Burn. To create a CDR disc.

CDR. Compact Disc Recorder: A device for burning CD-ROMs. Also, Compact Disc Recordable; aka CD WO or WORM (Write Once Read Many). Currently there are at least six companies marketing CDR drives at very reasonable prices, starting at a low-end of $2,500 to around $12,000 (see listing on page 77).

CD-DA. Compact Disc Digital Audio commonly known as Red Book. 72 minutes of 44.1kHz, 16-bit digital audio can be stored on a single CD.

CD-I. Compact Disc Interactive, a multimedia CD-ROM system produced by Philips for the consumer market.

CD-XA . CD-ROM eXtended Architecture. An extension to the Yellow Book standard that provides support for multimedia functions. Sometimes called a bridge format because it uses elements of both the Yellow and Green Book. An XA disc can store audio, video, picture, and computer data.

CD+G. Little-used system where graphic data is stored on a CD-DA disc in the subcode. The graphics are slow and limited, and few CD players can read them.

CD-V. Compact Disc Video. A disc that contains up to five minutes of video and 20 minutes of digital audio. Video can only be viewed on special players.

ECMA 168. Proposed standard for multisession discs. Proposed by the Frankfurt Group and accepted by the European Computer Manufacturers Association.

Mastering. The process of encoding data to compact disc standards and recording this information as a series of pits in a light-sensitive layer on a glass substrate.

MO. Magneto-Optical. Rewritable (erasable) optical discs.

Mode 1. An ISO 9660 Standard indication of the level of error checking. A Mode 1 disc has three layers of error de-

ROM, the default is an alphabetical listing.

If you're just transferring data to a disc and access speed is not going to be a critical factor, the order that the files appear on the disc may not be critical. But if you're interested in optimizing or reducing the amount of time it takes to retrieve information from the disc then there are a few things that you can do in the premastering phase to speed things up a bit.

Organized Labor

First, try and organize your data so that the less frequently used files are toward the outer edge of the disc. (CD-ROM data is written from the inside of the disc outward.) Since the distance between files is smaller on the inside tracks the seek times will be greatly reduced if the drive doesn't have to go searching very far. Transfer rates will remain fairly constant no matter where the data is located on the disc, but seek times can dramatically slow down total throughput. Many people put installation routines on the outside of the disc since they will be used less often. If your premastering software does not allow you to place files at specific locations on the disc, you can always put your installation routines in a directory called "ZZZ," which will force it to the outside of the disc.

Second, group files that will be used together in the same directory rather than by type. If you know that you will be calling up a text file and a picture file at the same time, put them into the same directory rather than having a picture directory and a text file directory. This will insure that the two files will be located near each other on the disc, thereby reducing seek times. In most cases it's preferable to have a hundred directories with only a few files in each rather than a few directories with hundreds of files in each. On a CD-ROM disc the practical limit is about 1,000 directories. Beyond that the system begins to slow down to maintain the directory structure.

The Compression Story

If you're developing games or full-blown multimedia discs and really need speed off a CD-ROM, there are some other options such as CD-XA (eXtended Architecture; primarily used with the Philips CD-I player), which allows the interleaving of graphic and audio information in the same file. You create a single large file that contains a set number of bytes alternately devoted to video and audio. The playback software instructs the CD-ROM drive to simply start dumping data to the computer in one long continuous burst as if it were playing a CD-Audio track. As the data pours into the computer the software sorts out which bytes are video and which are audio and routs them to the appropriate handlers on the fly.

Another option is to compress your data first and decompress it when it gets into the computer. This compression is not to save space but to speed data throughput off the disc. The drawbacks are that compression/decompression technology is still in its natal stages, and "standards" are obsolete almost before they get accepted as standards.

Hardware compression techniques such as MPEG (Motion Picture Experts Group) offer compression ratios up to 200:1 and realtime de-

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tection and correction and is mainly used for computer data.

Mode 2. An ISO 9660 Standard indication of the level of error checking. A Mode 2 disc has two layers of error detection and correction and is mainly used for audio or compressed audio/video.

MPC. Multimedia Personal Computer. Original specification from Microsoft for PC configurations that would insure a compatible hardware platform for multimedia playback.

MPC-II. More stringent (and realistic) version of MPC.

Multisession. A CD-ROM to which data can be recorded in multiple sessions. The first track is skipped and then a TOC (table of contents) is written for each added track. Sometimes a "traditional" ISO TOC is written at the final session on the first track. Not all CD-ROM drives can read multisession discs.

Orange Book Standard. Recordable compact disc standard. Part one of the orange book standard is for MO (Magneto-Optical rewritable) and another part is for WO (write once). Part two describes a write-once disc that can be written to in multiple sessions.

Photo CD. Format developed by Kodak for storing digitized photographs. A disc can hold up to 100 photos and must be used on a Photo-CD compatible system. Photo-CD discs are also multisession.

Premastering. Preparing the digital data the way it should appear on the CD-ROM, including the file structure. A premaster usually contains a modified directory structure that simply points to the files. Sometimes called an image.

Red Book Standard. Standard file format for CD-audio discs (originally published in a book with a red cover).

TOC. Table of Contents. Information located in the lead-in area of a disc (track 1, sector 16) containing a listing of where tracks start on the disc as well as indications to the player as to what kind of disc it is: ROM, audio, etc.

Virtual Image. Where the files to be recorded on a CD-ROM or CDR are arranged contiguously on a hard disk to facilitate their transfer.

Yellow Book Standard. The standard used for CD-ROM (originally published with a yellow cover), indicating that data rather than audio is stored on the disc.

compression speeds, but require that the playback unit also have the hardware decompression chips on board. If you expect your target platforms to have the right decompression hardware, you can create the compressed files and store them on disc as you would any other type of file. You should, however, investigate how well a particular hardware solution works on CD-ROM before investing in a technology.

Software compression/decompression solutions such as JPEG (Joint Photographic Experts Group), QuickTime, VFW (Video For Windows), Ultimotion (IBM's Software Motion Video), Intel's Indeo, or other proprietary techniques can't deliver the same playback speeds, but don't require special hardware on the target system. Another consideration is that you may have to pay a run-time fee for the playback software.

Compression schemes can also be categorized as lossy or lossless. Lossy techniques usually offer higher compression ratios but 100% decompression accuracy is sacrificed. When talking about video it doesn't usually make much difference if a byte or two gets changed or lost. With audio, dropped bits result in annoying clicks and pops that drive audio people crazy. But when talking about programming data the integrity of each byte can be critical. Lossless compression/decompression techniques can't achieve the same ratios as lossy techniques, but the decompressed data is a byte-for-byte copy of the original.

Real World Video Questions

If you really want to get video onto your CD-ROM you should expect to enter into a whole new world of production, software, hardware, terminology, and confusion. In a nutshell, there are no easy ways to put video on a CD-ROM.

The problem is that video contains a *lot* of information. For a rough idea of what you're up against, run this calculation yourself. A full-screen .BMP graphic file with 256 colors takes about 300k. A 24-bit graphic can consume well over a megabyte for one picture. Now multiply that by 30 frames per second. Add the audio and you begin to see some of the problem. Even if you get each picture down to under 100k per frame we're still talking about nearly 5MB per second. At that rate you could store about two minutes of video on a 650MB CD-ROM disc. Using a standard single-speed CD-ROM drive that reads data at 150 kilobytes per second, it would take over an hour to play back your two minutes of video.

Another problem with video is that the signals contain a lot of noise. Even in a "static" video sequence nearly every pixel will change from one frame to the next. It isn't noticeable when played back in real time, but it can choke

CD-RECORDABLE DRIVES

CDworks
3002 $19,990
3004 $22,990
Virtual Microsystems
1825 S. Grant St., Ste. 700
San Mateo, CA 94402
800.722.8299
415.573.9596
415.572.8406 FAX

JVC Personal Archiver $3,995
RomMaker $9,995
JVC
17811 Mitchell Ave.
Irvine, CA 92714
714.261.1292
714.261.9690 FAX

Kodak PCD Writer 200 Plus $5,400
w/formatting software
$8,199 (Mac)
$8,500 (Windows)
Eastman Kodak
CD Imaging
343 State St.
Rochester, NY 14650
800.235.6325
716.724.1021

Microboards PlayWrite 1000 $2,995
4000 $5,995
Microboards
Box 130
Carver, MN 55315
612.448.9800
612.448.9806 FAX

Philips
CDD521 $5,995
CDD522 $N/A
Philips
4425 Arrows West Dr.
Colorado Springs,
CO 80907
719.593.7900
719.599.8713 FAX

Pinnacle RCD-202
$2,495 (Mac)
$2,695 (Windows)
Pinnacle Micro
19 Technology
Irvine, CA 92718
800.553.7070
714.727.3300
714.727.1913 FAX

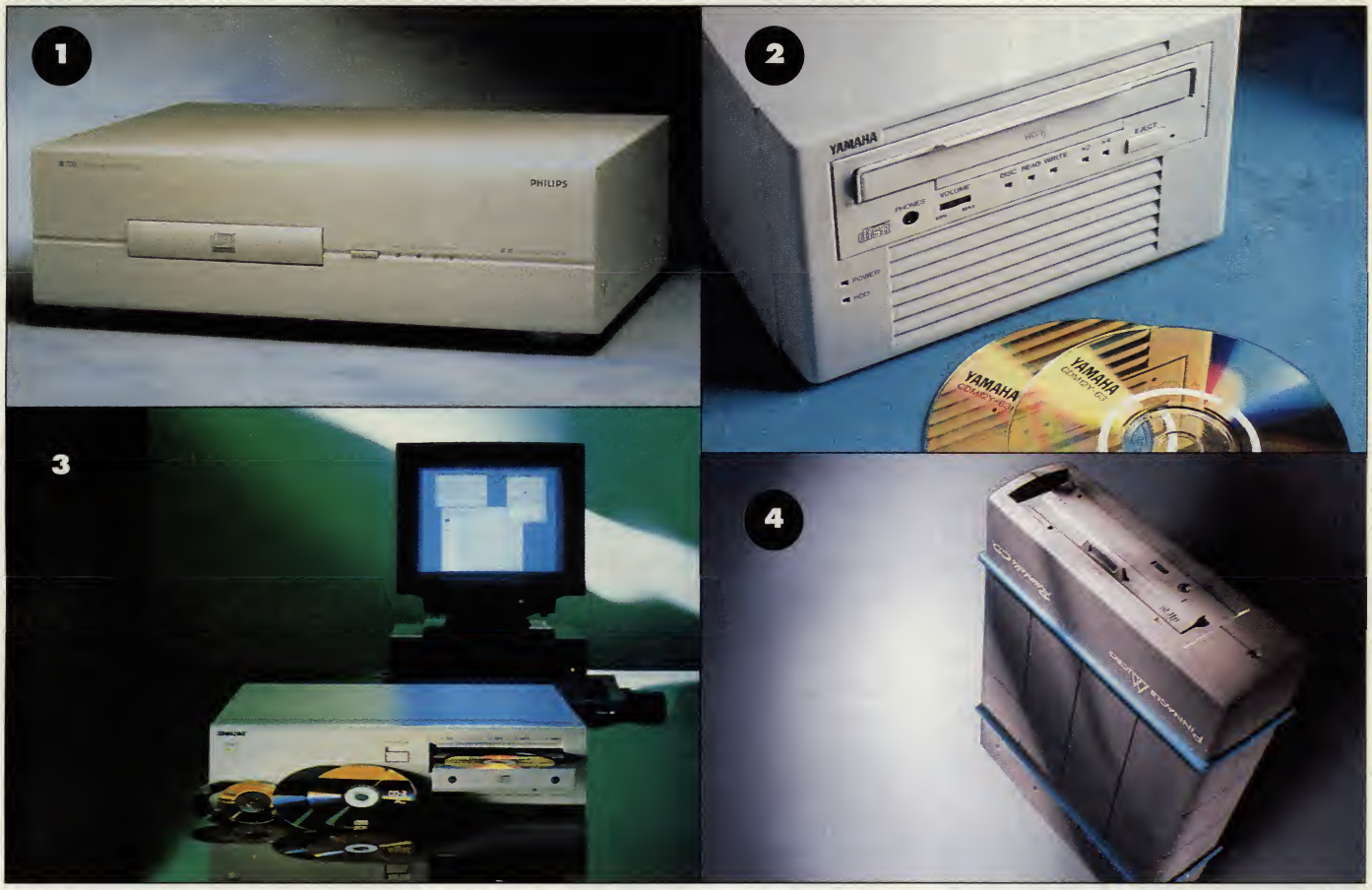
Ricoh
RS-9200CD $3,000
Ricoh
3001 Orchard Pkwy.
San Jose, CA 95134
800.955.3453
408.432.8800
408.432.8372 FAX

Sony
CDW-900E $6,995
also available as
Trace LH-2600
Sony Electronics
3300 Zanker Rd.
San Jose, CA 95134
408.441.3347
408.441.3420 FAX

Trace
LH-2600 $6,995
also available as
Sony CD-W-900E
Trace
1040 E. Brokaw Rd.
San Jose, CA 95131-2939
408.441.8040
408.441.3399 FAX

Todd Write-Once System YCDD-521
$5,995
Todd Enterprises
224-49 67 Ave.
Bayside, NY 11364
800.445.8633
718.343.1040
718.343.9180 FAX

Yamaha
CDR100 $5,000
CDE100 $5,500
CDE100H10 $N/A
Yamaha Systems
Technology Div.
981 Ridder Park Dr.
San Jose, CA 95131
408.437.3133
408.437.8791 FAX



Four CD-Recordable drives. 1. The Philips CDD522 is a second-generation machine that records all CD formats in 1X and 2X speeds. 2. The Yamaha CDR100 records all standard formats in 1X, 2X, and 4X speeds. 3. The Sony CDW-900E/also available as the Trace LH-2600 records at 1X and 2X speeds. 4. The Pinnacle Micro RCD 202 records at only 1X speed.

most normal compression algorithms that rely on redundancy in the information or only track changes from one frame to the next. Current video playback techniques get around these problems by reducing the number of colors, reducing the playback rate, and reducing the resolution.

Beyond the technical problems there is also the not so little matter of actually producing the video. If you have to create something from scratch you'll have to deal with scripting, lighting, video cameras, tape, video tape editing, sound, and the full set of production headaches associated with video. If you're prepared to launch into video production you'll have to look at the complete solution before you begin shooting.

Video formats, capture hardware and software, and playback solutions all have to match or the whole process is doomed from the start. You'll have to produce your video in a format (VHS, S-VHS, composite, component, Beta-sp, 8mm, Hi-8, etc.) that is both high-quality and one that your digitizing hardware can accept (most video capture boards accept composite video, but some require component or RGB). The digitizing hardware must also be able to capture in real time and save the video in a format that your playback solution can use (some capture boards save the video files in proprietary formats that can only be played back on systems that have that particular graphics board installed).

Once you have your video on tape, the next step is to digitize each and every frame. While there are some video capture boards that claim to capture video in realtime, most of them will drop a frame or two here and there, can only digitize a few seconds at a time, require massive amounts of storage space on your hard drive, and may or may not capture in a format that will be compatible with your playback solutions. Most capture boards will grab each frame or field of a video signal, store it uncompressed on your hard drive and then later go back and compress the signal using a compression algorithm such as JPEG. This is usually a time consuming process and the result may not be what you were expecting. The other options are to have your video put on laser disc, digitize each frame one at a time then rebuild the video file. Some video capture hardware/software solutions will automatically generate QuickTime or Video for Windows formats, which are probably the most common video playback options. If you plan to distribute your finished discs to the public, you may have to pay a runtime fee to include the playback software on the discs.

Unfortunately, while existing video techniques can only provide mediocre results, there are no alternatives short of developing your own video playback solution (a gargantuan undertaking). All of these solutions require another level of programming expertise and shouldn't be entered into lightly. It might seem like a nice idea to add a little video to a disc, but unless you have a firm grasp of the video digitizing and playback process it might be wiser to stick with nice static graphic screens and "traditional" computer animation.

The Front End

So far we've focused on the actual process of getting your information from computer to CD-ROM, but you'll also have to concern yourself with how information will be getting from

disc into the user's computer and how they will interact with that data. If all you're doing is storing text, database or spreadsheet data, MIDI files, synthesizer patches, clip art and other graphic files, you may not have to do anything about a front end or user interface. Just store the files on the disc and let the user load them into their software as they would load any file from a floppy disk or hard disk. (Note: it is NOT a good idea to put a copy of the word processor, database, or spreadsheet program on the disc unless you have permission from the company or wrote those programs yourself. Not only is it illegal, the programs may even not work.)

If, however, you're not sure whether your users will have the proper software to use the data, you'll have to provide some way for them to get at all that valuable information. This is where you start getting into languages, search engines, and authoring systems. If you or your people have programming expertise, you might consider writing your own front end for the disc. This program should be able to run straight off the disc, from RAM, or even have the user copy the program from the CD-ROM to their hard drive and run it from there. Again, you should keep in mind that the CD-ROM is read only, slow, and may not have the same drive designation as the development system you are using to create the disc. If your users will need to write to the data you'll have to have them transfer the files to their hard disks before running any programs.

If you have a great deal of raw data slated to go on the disc, you might consider licensing a search engine. A search engine is a program that facilitates data retrieval. For the most part a search engine creates a single giant index of your data and all queries to the data are made through the index. (Many times the search engine data index ends up being larger that the actual data that it points to!)

It's possible to program your own search engine or do without, but creating your own is a time consuming process and using traditional search methods may be very, very slow when the data is on CD-ROM. There are a dozen or more companies who have written CD-ROM-based search engines, and you should investigate the pros and cons of their various solutions as they relate to your specific needs. If you only have a limited number of files licensing a search engine may be overkill.

If you decide that you do need a search engine, investigate how much space the index will consume on the disc. If you have 450MB of data and the index takes 250MB you're in trouble. CD-ROMs only hold 654.7 megabytes.

Alternatively, you might consider an authoring program. An authoring program is a set of routines that someone else wrote to let you do things that are common in a presentation, such as showing graphics, formatting and displaying text, playing back animations, etc. There are dozens of authoring programs available for just about every computer and every task (for more details see the story on page 90). Some authoring tools are designed specifically for business presentations and others are almost programming languages in their own right.

Many authoring systems do not offer run-time versions (stripped down versions of the program that can play back a completed presentation or script but will not allow the end-user to create new scripts). When no run-time version is available, the entire program must be present on the playback system. Most of these types of authoring programs will not allow you to copy and distribute the program at all. Other systems that do have runtime players charge you a license fee for every copy of the player that you distribute. If you're amenable to paying a license fee, contact the company to find out where to go from there.

When choosing an authoring system, make sure it can do everything you want it to. Some authoring systems concentrate on text formatting only and can not playback animation or audio. Many are non-interactive and some may not work on CD-ROM. Investigate an authoring system carefully. Otherwise you could end up spending a lot of time developing a front end only to discover you can't use it on your disc.

At the very least, even if you don't have a nice front end or search engine (or both) you should have a read-me file on the disc that explains what is on the disc and how the user can access the information.

Formatting

Once you have all your data compiled on a hard disk and the front end built and tested, it's time to format the information. At this stage you'd perform any indexing processes that a search engine might need to perform followed by a little more testing. This is also the point in the CD-ROM production process where you will need vast amounts of hard disk space — remember a single CD-ROM will hold about 650MB; if you intend to fill the disc, you'll need enough hard drive space to hold a *virtual image* (see glossary on page 74) of that 650MB (even more if you're dealing with files that will eventually be compressed) plus however much you need to accommodate all your development apps.

Before you can transfer your data to a CD-ROM it must be formatted and converted into ISO or HFS format. While it's possible to send your unformatted files to a CD-ROM duplicator, they'll charge you a fee of up to $300 per hour to format the data for you. They essentially take your tape or hard disk and transfer all the files to another hard disk, where the data will be formatted as ISO or HFS or whatever format you choose. They will

DUE PROCESS

- Compile the data files onto one hard disk.
- Create the front end and/or search engine software that will control everything.
- Format and convert the data to ISO or HFS format using special software or send the data to a duplication house for them to format.
- Create a virtual image of the formatted data on a hard drive.
- Burn a CDR gold disc.
- Test the gold disc.
- Ship the gold disc off for mastering and duplication (along with any artwork for the label, inserts, and special packaging).
- Wait the 10 - 15 days that it normally takes the duplication house to produce the discs.

then make a test disc or one-off (usually a CDR gold disc), which will be shipped back to you for testing prior to mastering.

If you're planning on formatting your disc before you ship it to the duplicator, you need a special program that takes all the files that you specify and creates a build list. (See list of formatting software on page 80.) This build list contains all the proper header, error correction, volume names, and files as they will appear on the finished disc. Some formatting software allows you to edit this list while other packages organize things alphabetically. From the build list you can create a virtual image of the data on a separate hard disk or hard disk partition or you can transfer that image to some form of removable media such as SyQuest cartridge, magneto-optical disk, 8mm tape, 9mm tape, etc. That image tape or cartridge can then be sent to a CD-ROM duplicator.

Some formatting software will even let you simulate the disc at this point. It will slow down access times and simulate slow seeks so that you will get an idea about how your finished disc will really perform. If your application is going to be time-dependent in any way, it's a very good idea to test in a simulation mode before going on to burning a test disc. This will also give you a chance to find any other problems that may have arisen during the conversion of the files.

Bringing It In House

If you're planning to do a lot of CD-ROMs in the future or you only need a few dozen copies of each disc, you might want to consider purchasing a CDR device so you can burn your own discs. The advantages are that you won't have to pay formatting charges or one-off charges, and you'll have test discs right away. The disadvantages of buying a CDR device are that they can be difficult to set up, they require a certain amount of expertise to operate, and at $17 to $35 per disc mistakes can get expensive. There are also a few other hardware considerations you should think about before buying a CDR.

It might not have mattered much up to this point, but hard disk transfer speeds begin to become important when burning CDR discs. During the actual burning of the disc, the information has to be fed to the CDR drive at a constant speed from start to finish. If at any point in the process the hard disk can't keep up, the burn will be unsuccessful and you have just wasted a $20 gold disc. Hard disk transfer rates can be influenced

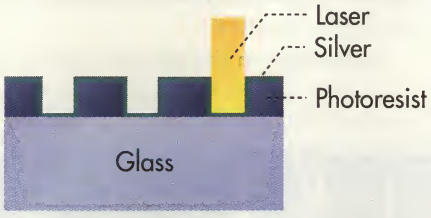
HOW CDS ARE REPRODUCED

1 GLASS MASTER

From the customer's data, the CD Glass Master is produced.

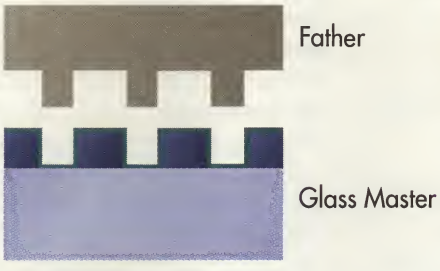
An optical ground glass disc is coated with a 1/10th micron thick layer of Photoresist which is then exposed by a laser. The laser "writes" or exposes a pattern of pits on this thin layer, transferring the information from the master image.

The disc is developed (the exposed parts are etched away), it is silvered, resulting in the actual pit structure of the finished disc.



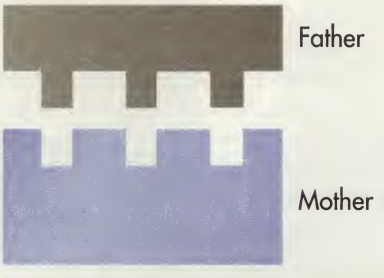
2 FATHER

The master is then electroplated with nickel which, when separated from the master, forms a metal negative or "father."



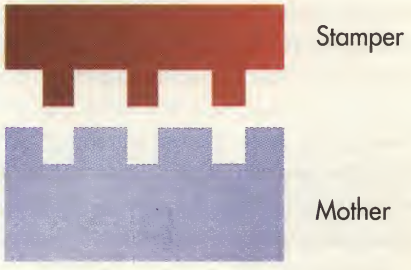
3 MOTHER

The father could be used to replicate CDs but would wear out too soon. Instead, several "mothers" (or positives) are made by plating onto the father.



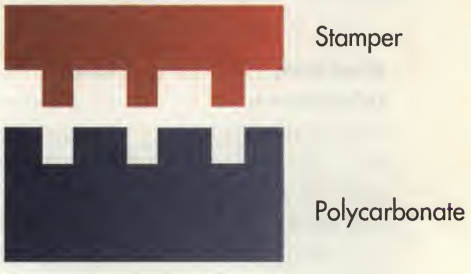
3 STAMPER

In the third plating stage, each mother is used to create a number of stampers, which are actually used to mold the pit structure onto the CDs.



5 CLEAR DISC

Compact discs are made similarly to conventional records using injection molding techniques and a stamper.

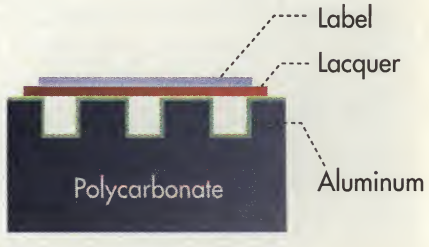


5 CD-ROM DISC

The information surface is coated with a micron thick layer of aluminum to provide a reflective surface.

This is the surface which is actually read by a CD Player. The reflective surface is then protected with a lacquer coating.

The disc label is then printed directly onto the disc.



"HOW CDS ARE REPRODUCED" COURTESY DISC MANUFACTURING, INC, WILMINGTON, DE

BURNING DOWN THE HOUSE

by a number of factors. The drive itself may not be fast enough. Some older hard disk drives had transfer rates as slow as some modern floppy disks. The hard drive controller can slow things down below the CDR drive's tolerances. Also, some hard disk drives have an automatic cool-down phase where the drive pauses for an instant between or during reads. These tiny pauses are enough to destroy the process. The operating system itself may cause hiccups. During the transfer process you should turn off all TSR programs, screen savers, and background tasks to insure that the operating system doesn't steal a few cycles from I/O during a critical moment.

Virtual Images

One way to avoid problems is to make sure that you're transferring from a virtual image rather than a test image. Test images are when the software simply points to the various files in an image and the hard disk fetches those files from wherever they happen to be. A virtual image is made in a separate partition from the build list of files that the formatting software created. In a virtual image each of the files are physically copied to a separate hard drive or partition before the transfer to CDR is made. That way all the files are in the same place on the hard disk, in the order that you wanted them to appear on the disc itself.

Another thing to keep in mind is that except for a very few multisession CDR devices, burning your own disc is an all-at-once process. All the formatted data and files get transferred to the CDR in one session. You can't use a CDR for incremental backups the way that you can use tape or MO devices. There's a proposed modification to the ISO 9660 standard put forth by the Frankfurt Group known as ECMA 168 that offers a solution to this problem. Essentially the tracks are written one at a time starting with track 2 and progressing outward. Each new track has it's own unique TOC (Table of Contents) pointing to the locations of the data. When the disc is full the CDR goes back, reads all the TOCs, and writes a finished track 1 (ISO 9660 requires that the TOC be located on track 1).

FORMATING SOFTWARE

American InfoScience
1948 South Interstate Hwy. "B"
Austin, TX 78704-3696
800.382.3766
512-440-0531 FAX
PRODUCT:
CD-Producer v. 1.6
$1,995

CD ROM Strategies
6 Venture Ste. 208
Irvine, CA 92718
714.733.3378
714.453.1311 FAX
PRODUCT:
CD-Gen (DOS/Windows/Mac) $1,195

Crowninshield Software
1050 Massachusetts Ave.
2nd Floor
Cambridge, MA 02138
617.661.4945

CSM
1532 Encinitas Blvd.
Encinitas, CA 92024
619.944.1228
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Continued on page 89

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Scoring for Interactive Media

Adapting Music to Changing States

BY DAVID JAVELOSA

There's a deafening noise out there — not the *VRAaaazzzz* of highspeed roadsters nor the thump and grind of heavy machinery, it's the cacophony of art and high-technology splanging head on into each other to form new mediums of interactivity. With these new media have come issues that have never existed before. Issues that artists and technologists need to come to terms with if they're to successfully develop compelling paradigms of interactivity. For composers, the opportunities within this new multimedia industry are incredible. From computer-assisted performance art to interactive video games, savvy musicians have the chance to pioneer new forms of composition, explore psycho-acoustics, and redefine the meaning of performance. And even make a living at it.

David Javelosa is on faculty at San Francisco State University's Multimedia Studies Program. He's also Senior Music Designer at Sega Studios, and tries to interact with real music as much as possible.

Where We Were

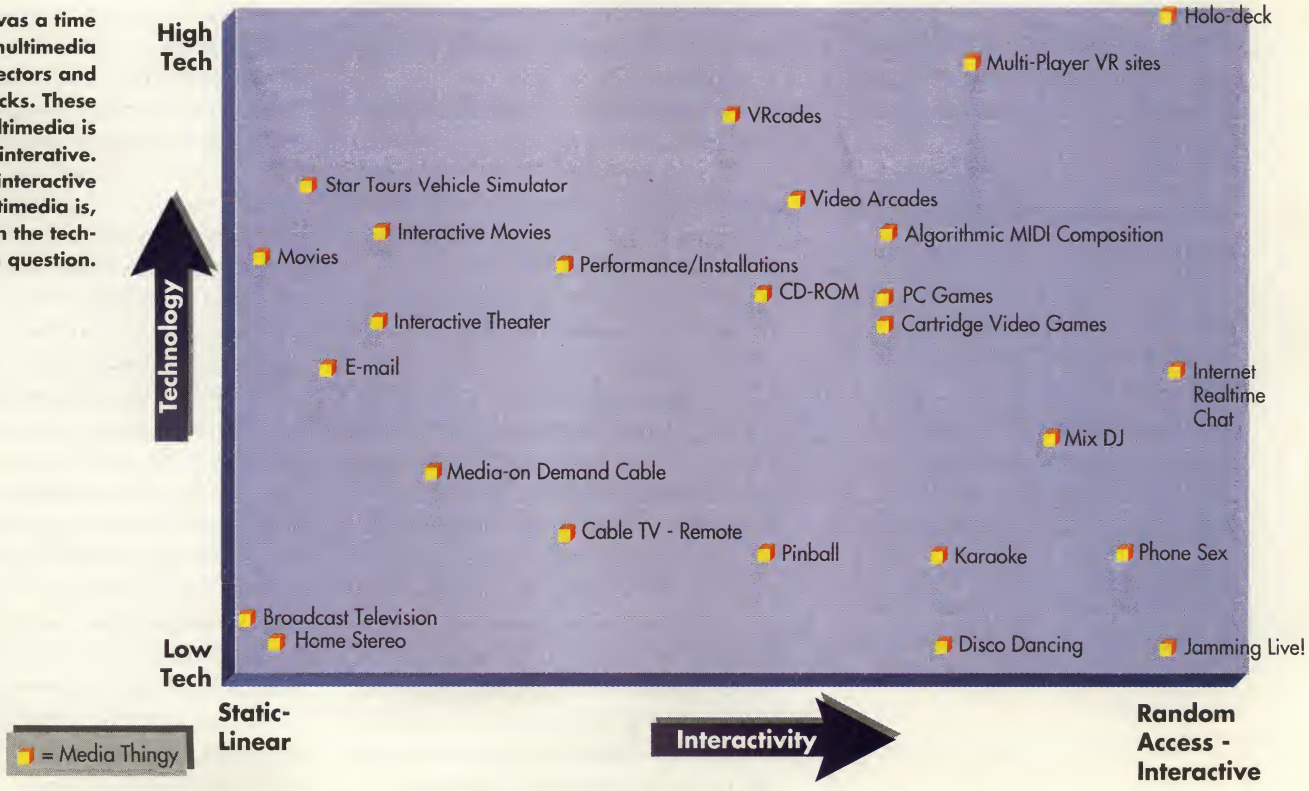
There was a time when multimedia meant using slide projectors and tape decks. That may seem like stone age technology today, but back then, it was a serious advance over the multimedia of silent movies accompanied by theater organists. Those musicians were aware they were interacting with something, but the audience was still in passive mode. Even after technology made it possible to synch sound to picture, the motion picture experience was and still is a passive one.

In fact, there aren't very many places you can look to find useful paradigms of interactivity in traditional forms of art and entertainment. Cross-disciplinary collaborations, of the sort encouraged in art schools involving improvisatory music and dance, have been really useful in discovering new relationships between the two mediums. They've helped redefine concepts of foreground/background, accompaniment/duet, and so on. Interactivity between the dancers and musicians flourishes in these collaborations, but it rarely gets conveyed to the audience. And it's even rarer that someone figures out a way to *involve* the audience in the interactivity.

Game Land

But in video games interactivity plays the

There was a time when multimedia meant projectors and tape decks. These days, multimedia is a bit more interative. Just how interactive multimedia is, depends on the technology in question.



INFOGRAPHIC: RICK EBERLY

lead role. Never mind the battle among manufacturers about which game machine or computer platform will be coolest, fastest, and most radical (dude!). A lot of people think technology is at its best when it's transparent. Just ask any software publisher. They understand that what counts is the game — that is, how compelling the experience is for the player *interacting* with the software. Much the same can be said for any other type of interactive product from the educational to the informational, but for now, let's stick with the gaming experience.

Anyone who's played a video game knows the player determines the action — the storyline isn't always linear, the movement through the game world can be quite unpredictable. So how do we as composers contribute to the interactivity of game play? That's a huge question. We'll be exploring that issue on an ongoing basis in this column.

According to Mark Miller, one of the leaders in video game music production, "One of the most difficult aspects of our work is to come up with terminology that allows us to describe the process of scoring games with clients. When we discuss interactive scoring elements in sound design, we begin with two concepts: *state changing music* and *modally adaptive music*. States refer to large, slowly changing conditions in which game players find themselves. For example, you've won, you've lost, you've entered an area of extreme danger. Modes on the other hand are fluid, quickly changing, and reversible conditions that cycle in and out of the game play.

"Once the states and modes of the action have been defined, producer, game designer, and composer can discuss how to correlate the changes in states and modes to compositional elements for best dramatic effect (see sidebar)."

Technology plays a major role in how well a product can affect these changes in its operation, and in some cases will actually dictate musical solutions. For example, if you're dealing with cartridge-based video game software, sound and music are driven totally from memory in the cartridge, so the technological limitations you'll have to deal with may revolve around the internal sound engine of the system you're developing for. Whereas typical software-based games often require covering up potential pregnant pauses caused by downloading data from a hard drive or audio tracks off a CD into RAM while the game is running.

It was just this scenario that Tom Miley had to deal with when he worked on the Sega-CD version of *Jurassic Park*. His solution was to program interlude music to play on the internal FM synthesizer while CD audio was being cued-up for the next game level. Since the user determines which path to take between levels, the interlude music is selected randomly from a list of possible pieces.

Musically, you draw on traditional and linear compositional experiences. Techniques for film scoring work to a certain point. The concepts of foreground dialogue, sound effects, and background score still hold. The eternal relationships of sound to visuals, instruments to dancers, scenery to action, still remain. You might assign specific themes or motifs to characters. But unlike film scores, the user/audience has to be choreographed into the scene. For example, you might assign specific themes to specific characters. As those characters change, so too might their theme. Since the user's actions control the character's action, the user is in effect altering the performance of the music.

In programming lingo, we're talking about *if/then* statements. For example, IF the player is in a certain territory, THEN the program plays a particular piece of music, or plays the music in a certain way. One example of this is in Nintendo's *Super Mario World*, which is included with the Super Nintendo Entertainment System. If you guide Mario through a level that's underground or in a cave, music that's very similar to what had been playing before your subterranean excursion keeps playing, but it's suddenly awash in reverb — a part of the built-in DSP that comes with the Super NES sound chip. Likewise, if Mario never visits the caves in the game, you don't hear the reverb effect.

This kind of stuff can get very complex in more involved game design. As Mark Miller points out, the brain will attempt to gloss over missing elements or unexpected changes in the transitions. But there are several ways to create a set of musically logical transitions from one state to another. With careful planning, knowing what material you're departing from and the choices of material that you're moving to, these transitions can be seamless. Perhaps the transition music will contain thematic elements of the last level but will be transposed to a new the key in the next level. Other compositional devices have included rhythmic modulations, instrumental combinations, or orchestrated crossfades.

Sometimes logic doesn't work at all. In the case of completely random events and seemingly random plot lines — common to the interactive experience of game playing — randomly generated musical elements are appropriate. If the player is anticipating the same thing over and over, hearing the unexpected contributes to a more enjoyable game-play experience. You've got a greater selection of potential outcomes when the player has a hand in inadvertently re-sequencing, re-arranging, or repeating the music.

What kind of tools are used for this kind of composition? Almost anything goes. Some rely on traditional sequencing packages to sketch out ideas, then hand them over to a programmer to port them into the game system. I use Opcode's Max for mapping interactivity, then either port the Max module or have the algorithm boiled down to some kind of machine code. My colleague Thomas Miley uses HMSL (Hierarchical Music Specification Language) developed at Mills College. Similar interactive software tools, such as Hookup and Interactor, might also be used. We'll get more indepth on the use of these tools, which all run within the MIDI environment, in future columns.

TREES AND BRANCHES

State changes are most often correlated to unique cues or specific locations within a larger composition. Another term for this type of compositional structure is a *branching* composition. As the game state changes the music driver (the *engine* that plays back the composition) jumps or branches to different locations within the composition or to a different piece of music altogether. In this way, you can achieve much of the dramatic effect of a traditional film score without the linear predictability of the film medium.

Our experience with branching has yielded an unexpected but fortuitous revelation. If a state change is accompanied by a dramatic visual or plot event, AND the new branch of the music opens with a strong and coherent motif, you can basically ignore most rhythmic and harmonic inconsistencies caused by the transition. Under these circumstances, the impact of the gameplay state change temporarily distracts the player from the music. The brain, struggling for coherency, simply glosses over the missing half of a beat or unexpected key change introduced by the act of branching. It simply picks up the definitive thread of the new branch and away you go.

— MARK MILLER, NU ROMANTIC PRODUCTIONS

Social Planning Along the Information Super Highway

BY BILL BUXTON

The Information Super Highway! It's being discussed on television, in magazines, newspapers, and on the radio. The only thing that exceeds the number of outlets where it appears is the diversity of the views and explanations "clarifying" what it's all about. On the one hand, we have proponents telling us that it will help create jobs and wealth, while improving government, education, and health care. On the other, we have the skeptics who, at best, see 500 channels of "mind candy" pandering to couch potatoes, and at worst, see forces threatening privacy and freedom. Each side, of course, dismisses the views of the other.

A first step in navigating through the conflicting views of the so-called Information Highway is to recognize that this is not a story about technology, nor are the associated issues primarily ones for engineers, technologists, or businesses. Rather, it is a story about people and communities. The issues are inherently social, and must be discussed as such if we are to avoid having, yet again, the tail of technology wag the dog of society.

As historian Melvin Kranzberg has pointed out, technology itself is neither good nor bad. Nor is it neutral! It's how we design, manage, and use it that makes the difference. The effect that these emerging technologies will have in the future is a matter of the choices we make today. Such decisions must be made from the social perspective. Without being overly dramatic, what we're doing is shaping social ecology in which our children will live. This we must do with care.

But who is making these choices, which versions of the future should we believe, and how do we determine whom to trust? First, let me emphasize the urgency of these questions. The decisions that will shape this future are being made today, and because of the scale of the initiatives, once made, their very inertia will make it difficult to change them after the fact. In simple terms, we are only going to get one kick at the can, and we'd better get it right the first time. My view is that we are at great risk of not doing so.

However much we may wish to believe otherwise, it is the potential for profit that is accelerating the debate and the development of the information superhighway. Home shopping and the video store at the end of a wire are what are in the drivers seat. Witness the feeding frenzy among media giants currently gracing the business pages.

Recently, I listened with interest as the CBC's national phone-in show, *Cross Country Checkup*, asked Canadians, "Are you ready for the Information Highway?" On the one hand, I was struck by the number of people from all walks of life who expressed how personal computers and networks, such as the Internet, had a positive effect on their lives. This is as it should be.

Bill Buxton is a professor in the Department of Computer Science at the University of Toronto. He's scientific director of the Ontario Telepresence Project, was a consulting research scientist at Xerox PARC in Palo Alto, California, and is now Principle Scientist, User Interface Research, at Alias Research, a Toronto-based highend 3D graphics systems company. He's a saxophone player as well as a technologist.

ILLUSTRATION: DAVID WEISMAN

MEDIA BABBLE

However, this also gave me all the more cause for concern because there was clearly confusion on the part of all between the Internet and the electronic highway that's being constructed by the emerging Cable/Telco alliances. Be clear about one thing: the more you care about the community of the Internet, the more you should be concerned about the Information Highway as envisioned by the Cable/Telco alliances.

THE IBA

The Internet Business Association was formed this summer in response to legislation making its way through the United States Congress. This coalition hopes to counter concentrated lobbying efforts on the part of the large coalitions of television/cable/telephone companies with their own lobbying. Says one of the IBA's founders Patrick Denker, "The legislators are only getting one side of the story." The IBA's other stated goals include fostering business opportunities on the Internet that are in keeping with the non-commercial spirit of the network. The focus is on the provision of information.

Most recently the IBA expressed concern that information providers are being held responsible for the content on their servers. It is the IBA's stand is that, just as bookstore owners should not be held liable for the contents of the books in their stores, information providers should not be liable for the vast amount of information traded online. Rather, the IBA believes, the responsibility should lie with the individuals who put the information on the server. This situation again relates in some ways to the government crackdowns on hackers, the most famous of which is Operation Sun Devil. In this case private BBS operators were arrested when contraband information was illegally placed on their servers by hackers. For more info: Internet Business Association, 655 Fifteenth Street, NW, Suite 200, Washington, DC 20005. 703.779.1320, 703.779.1362 FAX. Internet: iba@intercon.com.

The Lie of the Information Highway

The term Information Highway is misleading at best. First, it implies that what is being delivered is "information." But information is that which informs, helps us learn, and serves as the basis for decision making. Information is not something that is spooned into us, or that we absorb like a sponge. It is acquired through experience, experimentation, and — yes — mistakes. From this perspective, what will be mainly available from the systems being deployed by the major cable and telephone companies hardly warrants the name "Information." Second, this is no highway. Rather, what's being proposed is a tollway, with all of the inhibitions to free exploration of the community that the term implies (and therein, by the way, lies the seed for destroying the culture of the Internet). So let's not mince words: What's being proposed is more honestly described as a Data Tollway, not an Information Highway.

Interactive Television?

Discussions of the new technologies are dominated by the term Interactive Television, with implications that some great gateway to new beneficial services is being offered. The problem is the limited notion of interaction embodied in these systems. It's a form of interaction that permits you to *select*, not *create*. You can choose among your 500 TV channels, home shopping, etc., but you can't create your own information. It's simply a fancy remote control, which does little, if anything, to support notions such as distance learning, telemedicine, telecommuting, or the home information provider.

Interactive television is very different from broadcast television. By analogy, *interactive television is to broadcast television what the telephone is to radio* (since the telephone is interactive audio, while radio is broadcast audio). Any model of interactive television that does not acknowledge a change of paradigm of this magnitude is missing a large part of the potential of the technology.

The notion of interactive television being offered to the public is narrow, short-sighted, and sells the public (and business) short. To reap the true benefits of the technology, the second-rate interactivity must be resisted. We can and must do better.

Neighbors, Access, and Privacy

Perhaps the issue of privacy is behind people's concerns about these technologies more than anything else. I worry about the term, since it has a negative, paranoid connotation. So to put things in a more positive perspective, let's talk about this concern as one of the individual's right to control their own accessibility. Unchecked, these technologies leave us open to massive electronic junk mail. As distance ceases to be the determining factor of who is a member of your immediate community — that is, when everybody is a neighbor — how do you establish and maintain social distance when desired? And how do we control access to the *data trail* (as in *paper trail*), that traces all of our activities —that's ever easier to follow?

With planning, and assuming we understand the issues soon enough, there's cause to believe that such issues can be dealt with in a responsible way. I believe that there are three levels at which to address them. First, the technology itself can have hooks built into it that provide control over some such concerns. As a simple example, in my office, my door is hooked up so when it's closed, incoming calls are blocked. The same technology (the door) that discourages intrusion from unwanted physical visitors, also blocks electronic intrusions. So, by appropriate design, one technology can address problems introduced by another.

But not all issues can be solved in the technology. Sometimes, it's far more appropriate to have a social fix. As we gain experience, we'll adopt social morés that provide pressures that

THE INTERNET SOCIETY

The Internet Society, an international coalition of more than 150 organizations, is dedicated to the further development of the Internet. To judge from the information it provides online, the thrust of this group is more academic and technological. From the point of view of developers as well as users, however, an important aspect of the Internet Society's mission is the development of standards to increase Internet access and make it easier. For more information contact the Internet Society, 12020 Sunrise Valley Dr., Suite 270, Reston, VA 22091. 703.648.9888, 703.648.9887 FAX. Internet: membership@isoc.org (individual); org-membership@isoc.org (organization).

affect how we use technology. For example, experience with cellular phones is getting to that stage of maturity where it's largely unacceptable to have your phone on in a restaurant. That is to say, we are learning when and how to use that most important control, the on/off switch. As a guideline, we might look at the self regulatory efforts by members of the Internet. Those who violate the anti-commercial code of the Internet with unsolicited advertisements are roundly chastised and even, if the crime is egregious enough, electronically exiled. Given the means available today, there's no excuse for blindly throwing technology at society without consideration of potential problems. It's bad design, bad manners, and ultimately, bad business.

Universal Access or Haves and Have Nots?

Let's assume the services and functions offered on the Information Highway are of value. They help educate, generate jobs, improve the delivery of government services, and make it easier to participate in society. There seems to

THE ELECTRONIC FREEDOM FOUNDATION

As documented by Bruce Sterling in his book, *The Hacker Crackdown*, the Electronic Freedom Foundation was established in July, 1990 by Lotus founder Mitch Kapor to preserve our freedoms as guaranteed in the Constitution and the Bill of Rights in the electronic world as well as the real world. At that time, Operation Sun Devil was in full swing, and government agencies were arresting young computer hackers, and impounding their equipment citing only vaguely worded threats to national security as their justification. The crackdown reached its logical and most frightening extreme with the raid on Steve Jackson Games in Austin, Texas. Claiming this time that a Jackson game in development was actually a how-to manual for hackers, the government almost managed to shut down the small business by taking their computers, typesetting equipment, and games in production. EFF helped publicize the cases in all its more ludicrous aspects, and helped with legal fees.

Presently, the EFF is pressing its advantage against the Clipper chip technology championed by the National Security Agency. If implemented in the way the NSA would like, Clipper chips would be installed in every communication device including telephones and computers and would allow transmissions to be encrypted. However, the Catch 22 would be that the government would, in theory, be able to decrypt any transmission it deemed a threat to national security. Given Steve Jackson's experience, the EFF's concerns seem well founded. Former Clipper chip advocate, Al Gore, however, is in the process of fast backpedaling on his former enthusiastic support of the Clipper chip due to long, loud, and sustained opposition — not the least of which is coming from the EFF. For more information, contact the EFF at Electronic Freedom Foundation, 1001 G Street NW, Suite 950 E, Washington DC 20001. 202.347.5400, 202.393.5509 FAX. Internet: ask@eff.org.

THE LEGISLATIVE ANGLE

There is a collection of laws making their way through the United States Senate and the House, which are designed to lay the legal groundwork for the Information Super Highway. As is usually the case with our legislative system, it doesn't hurt to pay attention to what is going on especially as it relates to the Internet now and in the future. For those developers already investigating the possibilities of online delivery systems, these emerging laws could directly affect your products being developed:

The fast advance of technology has required that some of the laws put in place to restrict the monopolistic tendencies of the phone companies and the cable companies be reconsidered. The emerging alliances between telephone, cable, and entertainment companies were in part required by laws that prohibited phone companies from providing video services, or television broadcasters from owning cable companies or newspapers. Who knew that telephone companies could *become* video companies, and who knows now that we want them to?

At issue is electronic access to the home. With phone lines, cable lines, the TV and radio, there are already plenty of lines running into almost every house in America. Should the phone companies provide video, or the cable companies provide telephone services? And let's not forget the potential for wireless communication, AT&T hasn't. All it takes is access; but how will the quality of information be affected by the path it takes into the home. Be it phone company, cable company, or new entertainment network, whoever pays for expanded access to the home is going to want to make the most money out of the investment.

On the other hand, the preservation of competition is crucial to preserving the quality of services provided. That is a major platform of such organizations as the Internet Business Association. Lots of lines into and out of the house will insure a variety of services. Also, it is important that access to the new information services in the future be guaranteed in the same way that basic phone services are now guaranteed, and this issue is also addressed in the laws making their way through the House and Senate.

The House is considering two bills: House Bill 3636, introduced by Edward J. Markey (D-Mass.) and Jack Fields (R-Tex.), which addresses local exchange service, cable competition, and universal service; and House Bill 3626 introduced by John D. Dingell (D-Mich.) and Jack Brooks (D-Tex.), which addresses long distance service, manufacturing (for instance, of telephone equipment by phone companies, which is now illegal), and information services. In the Senate, Bill 1822 addresses infrastructure and includes much of what's in the two House bills. It's based on an earlier bill introduced by Senators John C. Danforth (R-Mo.) and Daniel K. Inouye (D-Haw.).

It may be true that two things you never want to see made are sausages and laws, but ignorance is a dangerous luxury. Consider the somewhat ominous Clipper chip initiative with its *1984* overtones and don't forget the experiences of those caught up in Operation Sun Devil. Contact the offices of the Representatives and Senators listed above for more information about these pending bills and let them know what you expect of the Information Super Highway. So far, the lobbying effort has been fairly one-sided and it's come from the emerging mega-companies.

— KATHLEEN MAHER

be general agreement if we are not to have a group of disenfranchised citizens, then access to such systems must strive for universality. Here again, however, it's critical to realize the issue of access goes far beyond technology. Three criteria must be met to achieve true access: *physical* access, *economic* access, and *cognitive* access. If any one of these criteria is missing, the services provided by the technology is inaccessible and the would-be beneficiary becomes disenfranchised.

Physical accessibility is what we most think of when we think of access. It involves the provision of the terminal equipment and the connection to a network. It's the most likely to be provided (but making it universal is no trivial feat).

Economic access is mentioned less often, but is critical. One doesn't need a Ph.D. in communications theory or sociology to recognize that near universal affordable access to the telephone forms an important part of modern life. So will it be with access to services on the emerging networks? Who decides what is "affordable," and have the people setting or regulating tariffs really done the research to understand the parameters of their decisions? I think not. Consider the difference between making a local phone call in most of the U.S. and Canada where a flat rate is charged, and in the Europe where the rates are charged according to time and distance just as if it were a long distance call.

The effect of this difference in charging structure is that the use of home computers and modems to connect to networks is practically non-existent in Europe as compared with North America. In North America, from home the Internet is a freeway. In Europe, it's a tollway. Not only do far fewer people use it, but those who do are at far less at liberty to explore and wander around, getting to know the community and what it has to offer.

There's a danger that with the changeover in technology in deploying the Information Highway will come a switch to a tariffing structure much like the European model. This is something that the North American phone companies have wanted for a long time, and may well be in the cards in the near future. I'm not at all convinced that this is in anyone's long-term interest, including the phone company's. It certainly does not auger well for universal access for citizens.

Finally, there is the most neglected, but perhaps most important aspect of access: cognitive access. It's not enough to have a terminal, network connection, and economic means. If you don't know how to use the system, you're just as cut off as you would be if you had no electricity. In a society where people with Ph.D.'s have trouble dealing with the technological gadgets surrounding us, I really question the degree to which reasonable access can be provided within what might be called the Threshold of Frustration, or the Complexity Barrier. This issue is amplified further, when we consider the additional problems of the aged, those with disabilities, or the millions of North Americans who are functionally illiterate.

We can reap real benefits — social, cultural, economic — if we invest less in the study of the asphalt and more on the controls on the vehicles that are to pass over the Information Highway. And if we pay as much, or more attention, to the social aspects as we do to all things technological. At the moment, however, things are greatly skewed in favor of the asphalt. We, the public, should be concerned.

BURNING DOWN THE HOUSE

Continued from page 82

won't have any problems with the finished product (unless the duplication house makes a mistake, which is rare). In fact, most CD-ROM duplicators would prefer CDR gold discs because they're easier to handle than other media and the client knows that the disc will work the way they want it to.

When you've tested your gold disc (whether you burned it yourself or had a duplicator do it for you) the next steps are mastering, duplication, printing, packaging, and distribution. You should contact the CD-ROM duplication house a month or two in advance so they know that your order is coming and they know what to expect (raw data, formatted SyQuest, CDR, etc.). They'll send you guidelines for disc label artwork and can discuss various packaging options with you. If the duplication house made the gold disc for you, all you have to do is call them up and tell them to go ahead. If you made your own, you'll have to send a copy of the disc to them.

Most duplication houses charge between $500 and $1,200 for mastering (on large orders many duplicators will waive these charges). Once the master is made, the actual CD-ROM manufacturing process is very much like pressing traditional vinyl LP records. Depending on the number of discs you want duplicated the costs can run anywhere from $1.80 each for a few hundred down to $.80 each if you're pressing many thousands. Duplicators can print just about anything you want on the top surface of the disc (in up to five colors), but nothing can be put on its underside.

There are dozens of options for packaging that your duplicator will be more than happy to discuss with you ahead of time. Just keep in mind that any instruction sheets or custom packaging should arrive at the duplicator before your order goes to press, or you're going to be stuffing your own discs into boxes.

If you think you might end up wanting more copies of the disc, be aware that most duplicators will charge you a remounting fee (usually around $300), so it's probably better to run off a few hundred extras the first time around. Duplication houses will also be happy to drop-ship orders wherever you like, and work with you on logistics.

The Bottom Line

The whole process isn't as complicated as you might think, but there are many pitfalls along the way. Expect to run into problems and frustrations on your first disc, but keep in mind that it used to be much more difficult than it is today. If you anticipate problems they hopefully won't turn into disasters.

CD-ROM production is still a relatively new dimension of the technological revolution, but it's getting easier and easier to produce your own discs. Prices are dropping, software and hardware are getting easier to learn and use, and more and more people have CD-ROM drives. Perhaps someday we'll all be making our own CD-ROM discs, but for now, if you follow these guidelines and create your very own CD-ROM discs, you can count yourself as one of the few hands-on experts in the field.

Multimedia Authoring Systems

Buy or Build?

BY WILLIAM VOLK

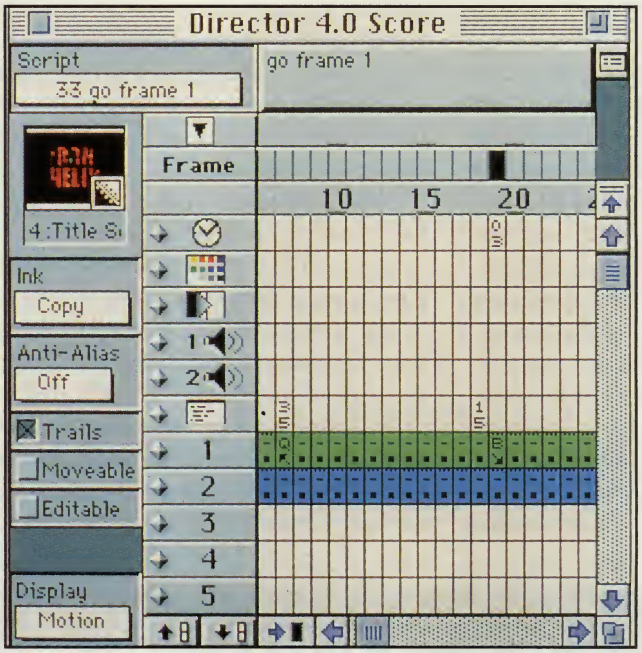
I've been involved in multimedia developmentfor the last 10 years or so with Aegis and Activision. I've participated in conferences with titles such as "CD-ROM: This is the year we make it happen," "Optical Media: Really going to happen anytime now," "Multimedia: O.K., So we were wrong last year, but . . ." "CD-I: Birth of a Billion Dollar Industry."

Yes, that last one was actually the name of a conference that happened in Florida in the late '80s. Delta Airlines lost my luggage. The CD-ROM/Multimedia Industry spent most of the late '80s and a good portion of the early '90s waiting for that Billion Dollar Industry to appear. A lot of folks lost more than their luggage.

But happen it finally did. And, as always, not in the way we thought it would. Personal computer multimedia CDs "happened" in a big way in 1993. The sales of CD-ROM titles exploded. The Software Publishing Association figures show around 24 million computers in the home, 34% are equipped with CD-ROM drives. That's over eight million players. CD-ROM titles such as Virgin's *7th Guest*, Lucasarts' *Rebel Assault*, Microsoft's *Cinemania*, Activision's *Return to Zork*, and Broderbund's *Myst* have done quite well. Some of these titles are expected to sell over a million units.

Which leads to this column's topic. When you decide to create the Great American Interactive Title, you'll have to make many decisions. One of the most important is the choice between using a commercial authoring tool such as Director or creating your own authoring system to develop your masterpiece. The decision to buy or build an authoring system isn't easy. Existing authoring tools can be used to create successful titles (*Myst*, which was developed with HyperCard and QuickTime movies, is an excellent example), but there are risks. Just as building your own authoring system can be a costly endeavor.

I've lived through both development scenarios. During my six year tenure at Activision, much of my time was devoted to the design and development of an authoring system known as the Multimedia Applications Development Environment or MADE. This was the engine behind *Return to Zork* (Mac, Windows), *Rodney's Fun Screen* (DOS), *The Manhole* (DOS), and other titles.



Macromedia's Director metaphor could be likened to multitrack audio recording or MIDI sequencing, where each track displayed represents one media type or another as identified by icons (seen left of center here). Time is represented horizonally from left to right.

I've also been involved with HyperCard- and Director-based title development. Currently, as the director of interactive development at a new company called The Lightspan Partnership, I'm working on creating Interactive Television programming for the education market. At Lightspan we prototype our titles using Director, Authorware, and HyperCard.

To build or to buy isn't a black and white decision. The title you envision, the hardware, the market, and your financial resources all play a part in the decision. I also hope that a hybrid approach will become possible, but that depends on a maturation of the policies by authoring systems firms.

An authoring system can be loosely defined as a program or set of programs that enable creation of an interactive title and provide a runtime program that executes the completed title. These programs or authoring tools can range from a game interpreter that requires the same level of programming skills as a conventional computer language to the all-in-one authoring environments as best represented by Director, HyperCard, or ToolBook.

Commercial authoring tools offer many advantages over rolling your own.

1) **The cost of building the tool is amortized over many customers and a long period of time.** Useful systems can be purchased for a few hundred dollars.
2) **These tools are of commercial quality.** That is, they're (hopefully) tested and debugged by the internal quality assurance staff, as well

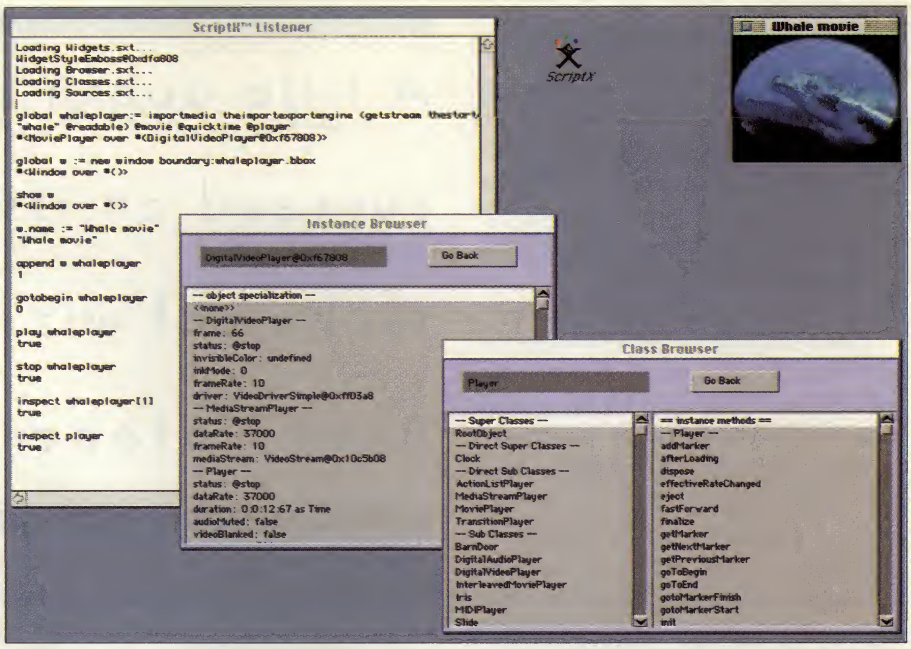
William Volk spent six years with Activision as director of development and was instrumental in creating *Return to Zork*. He is currently director of interactive development at The Lightspan Partnership, creating interactive television.

as the many customers who used previous versions of the system.

3) **It's possible to contract or hire people experienced in using the tool.** Training costs are reduced.
4) **The tool may run on more than one system, expanding your title's market.**
5) **If a revision to a computer system breaks the tool, the vendor should fix it.** The systems are often updated to take advantage of new hardware and software features of the hardware platforms they support.
6) **Using a commercial authoring tool forces the design team to concentrate on content, since the capabilities and features of the tool are fixed.** Too often titles focus on a neat technical trick, at the expense of production values, story, or interactive design.
7) **The development schedule is more predictable since there's no invention or R&D involved.** Many slipped schedules are due to the unpredictable nature of new technology development.
8) **Many commercial tools make it easy to localize your products (that is, translate to non-English lanuages) for export purposes.**

The benefits of using a commercial system are offset by limitations. Developers are often forced to create an authoring system by these limits. These include:

1) **There isn't a commercial authoring tool on the hardware platform you want to support.** This is currently true for almost all the new multimedia consoles; Jaguar, Saturn, Sony PS-X, and even, to a certain extent, 3DO.
2) **The run-time requirements of the authoring tool don't match your intended market.** An example would be an authoring tool that creates an application requiring an 8MB system when your market is full of 4MB machines.
3) **The performance of the authoring tools is inadequate to provide the response desired.** Faster hardware systems and improvements in the authoring tools have reduced this problem, but a customized authoring tool that's focused on your title design will typically exceed the performance of the commercial systems.
4) **Your design has features that are not provided by any of the authoring systems.** An example would be realtime 3D graphical environments such those in games like *Doom* and *Pathways into Darkness*. Some authoring tools allow programmers to add features to the tool, but a complex feature like realtime 3D could be impossible to add.



Unlike more traditional authoring tools such as Director, HyperCard, or ToolBook, Kaleida's ScriptX is not a metaphor-based authoring system, but rather an advanced object-oriented programming language that will run under Windows, Macintosh, and UNIX environments.

SCRIPTX

ScriptX is not a metaphor-based authoring system *a la* Macromedia Director, HyperCard, or Toolbook. Traditional authoring systems use a metaphor to represent the multimedia presentation. In Director, a timeline or score is used. HyperCard uses the concept of a card to represent the project.

In ScriptX, an advanced object-oriented programming language controls the entire multimedia presentation. Commands and objects are defined to access the graphics, audio, and interactive features. Facilities are provided for the storage of objects and the addition of native code to access specific features of a platform.

The goal is to have popular tools support ScriptX in the same manner that word processing software supports PostScript. For instance, Director, Toolbox, and Premiere would output ScriptX files. So far, the authoring tool companies haven't shown much proactive interest. However, Kaleida is working on a tool that will export some data from Macromedia Director files.

ScriptX currently runs under Windows, Macintosh, and some UNIX platforms. Unfortunately, ScriptX's runtime memory requirement is currently two to four times the available memory on the new multimedia consoles. Because the market dictates that game consoles cost something like $500 or less, memory is one of the first luxuries to go.

AUTHORING REALITIES

5) **A custom high performance authoring system adds value to the company.** The tool is even more valuable if it supports development on several popular hardware platforms with a minimum of porting time.
6) **You and your technical people just know that you can do a better job.**

I started designing the MADE authoring tool at Activision in 1988 to port *The Manhole*, a HyperCard product, to DOS and other hardware platforms. Our task was to move a B&W HyperCard title to a 256-color PC that had less than 500k available memory and a slower processor than the Macintosh *Manhole* was originally designed to run on. The title had to ship on 320k floppies (it was originally on five 800k Mac floppies) and had to run with or without the benefit of a sound system. That required us to produce digital audio by turning a speaker on and off.

Of course, personal computers have improved in the last six years. The hardware is better. Most people buying multimedia products have better machines with at least a reasonable amount of memory and soundcards. Commercial tools are stronger as well.

How to Choose

Sometimes the title you want to create isn't suitable to an authoring system and might be best programmed in a traditional language or assembler. The tools for that approach have improved as well. For instance, tools such as Visual C by Microsoft offer many of the high level features of an authoring system with the low level capabilities of the C++ language.

An appropriate title for authoring systems is one that's based mainly on content (images, video, audio, music) and less on action (an arcade game or simulation). The typical multimedia title for which authoring systems were designed uses a point and click interface to create an interactive experience. In contrast, a flight simulator uses a realtime 3D system and a high performance program to recreate the experience of flying an aircraft.

However, even simulations now have extensive game shells or multimedia sections where you perform game setup, receive missions, or have the story presented. These sections lend themselves well to creation with an authoring system.

Even if you have the most gifted technical staff, there are enormous problems in creating your own authoring system. The design of these is complex enough that you could devote a series of books to the subject. In other words, even with the best designers and engineers, there are a zillion ways to go wrong.

> A title doesn't succeed on its technical wizardry alone.

Beyond the design problems, creating an authoring system raises a lot of issues, including:

1) **Cost.** The cost of developing the system may exceed the cost of simply programming the first title in a conventional programming language. Of course, the idea is to recoup the development cost over several titles.
2) **Reliability.** Since the authoring tool is being created for use by a very small group, it doesn't benefit from having the many users a commercial system has. This often results in a tool that isn't easy to use and may suffer from bugs.
3) **Maintenance.** The tool will have to be modified to keep pace with new hardware and software developments. Since the tool is in house there's often pressure to add features since "the programmers are here anyway." In a large organization it's easier to spend $10,000 on software development labor than to spend $500 for a commercial software package.

So how to make a decision? The character of your development team is a critical factor. If your team is content oriented (artists, writers, and designers predominate) then a commercial tool makes sense.

If you're not a publisher, you can use a good commercial system on a platform you're comfortable with. Once you have a successful title, your publisher can handle the conversion to alternative hardware platforms. Publishers often have systems and staffs devoted to that process. *Myst* was developed on the Macintosh by Cyan, but Broderbund, the publisher, ported it to Windows. Cyan benefited from Broderbund's investment in Windows programming, and could concentrate on content issues.

If you have a group of excellent systems software engineers, and you want to push the limits of what a multimedia title can be, then you may want to build your own system. This is no guarantee of success. A title doesn't succeed on its technical wizardry alone. It's quite possible to create successful titles on commercial authoring systems and it's possible to create failures even with the most advanced multimedia technology.

There's a third approach that I hope becomes more common in the future. The concept is to use a high level authoring system on a well equipped hardware platform, such as a PowerPC running Director or a Pentium running ToolBook. Then an *authoring compiler* converts the project into a low level multimedia executable that runs on the desired platform. The code created by the authoring compiler is designed to run with very little memory or performance overhead. The authoring compiler creates a machine specific version of the multimedia title optimized for that specific platform.

Developers who prototype titles with commercial authoring and animation systems and then use conventional programming systems to create games with their own look and feel are using a variation of this approach. Furthermore, ScriptX, still under development at Kaleida, was originally announced as a scripting language to create portable multimedia applications. However the problem is that many of the commercial systems have limited (if any) export capabilities and at the moment it's not in their interest to add them. Often you can individually export the multimedia elements, but not the interactive whole. Developers have gone so far as to reverse engineer the formats of commercial systems to mine the interactive information locked away in their proprietary formats.

This situation is akin to word processors exporting data in ASCII only, or only supporting a particular type of printer. Fortunately, the vendors of word processors make efforts to support more than their own formats and ASCII. In particular formats, such as Rich Text attempt to encode font and style information while PostScript provides device independence for printing.

We can hope ScriptX or something like it will become a sort of PostScript for Multimedia. Meanwhile, we have access to some excellent commercial development tools that are improving year after year. There's an excellent market for great CD-ROMs, and Interactive Television should happen real soon now. But as Todd Rudgen says: "It's the content, stupid."

MULTIMEDIA AUTHORING SYSTEMS

When shopping for an authoring system, there are a lot of factors you'll want to consider. Choose your tools to match your development, and target platforms, and your needs. Some authoring systems include full-blown word processors, drawing programs, animation programs, search engines, programming languages, and on and on. Others offer some media editing functions, with the expectation that you'll be creating your content on various high-power applications then importing them into a media integration system. Virtually all the systems listed allow you to do hypertext and create so-called "hot spots," areas onscreen that when clicked or otherwise selected will produce some action. With that in mind, the list below specifies the platform(s) the authoring tool will run on, its price, a quick overview of capabilities, and a list of importable media and file formats.

Caveat emptor: We collected this data from literature sent to us by each manufacturer. When we were in doubt, or if their information was simply incomplete, we called. Most often, we got answers. Sometimes we left messages. A few manufacturers either ignored requests for information or couldn't get through to our lines (this issue was being prepared at the same time our sister publication *Keyboard* was putting together a comprehensive Music Software Buyer's Guide and tying up every fax machine in our building).

We attempted to standardize the file format nomenclature as much as we felt comfortable with. For example, we used WAV throughout instead of the other common variations: .WAV and WAVE. When we encountered format inconsistencies, we defaulted to what manufacturers reported (for example, we listed Intel video (AVI) and Video for Windows separately, though we often found them both called AVI; likewise for MOV and QuickTime movies).

Prices are manufacturer's suggested retail prices. We apologize to those manufacturers whose detail we were unable to obtain in time for our deadlines. And we apologize to anyone whose product we omitted — if it's not listed here, we didn't know about it. Send info to *InterActivity*, 411 Borel Ave., Ste. 100, San Mateo, CA 94402 or e-mail it to interactivity@mfi.com and we'll be happy to tell our readers about it in a future issue.

ADVANCE MEDIA
10231 Slater Ave., Ste. 112
Fountain Valley, CA 92708
714.965.7122
714.965.7118 FAX

Media Master (DOS/Windows) $995.

Media Master Pro (DOS/Windows) $1,495.

AIMTECH
20 Trafalger Square, Ste. 300
Nashua, NH 03063
800.289.2884
603.883.0220
603.883.5582 FAX

CBT Express (Windows, OS/2, Mac, UNIX by end of the year) $2,995. Computer-based training (CBT) course development system for first-time developers. Includes pre-designed course maps, student progress/testing tracking database. Imports text (ASCII, RTF through embedded text editor), graphics (BMP, PCX, RLE, WMF, GIF, PICT, TIFF, etc.), animation (FLC, FLI, AAS, AWM, AWA), audio (WAV and MIDI), video (AVI, AVS, MOV, MPEG). MCI compatible. No runtime licensing fees.

Icon Author (Windows, OS/2, Mac) $4,995 (Unix/Motif) $10,000+. Kiosk, CBT, and presentation development tool for non-programmers. Includes SmartObject editor, automatic file compression, graphics editor, video editor, DLLs. Supports OLE. Imports text (ASCII, RTF, proprietary), graphics (BMP, DCX, DIB, EPS, GIF, ICO, JPEG, PCX, PICT, TGA, TIFF, WMF, WPG), animation (FLC, FLI, AAS, AWM, AWA), audio (WAV, MIDI, CD audio, DMA), analog and digital video (AVI, AVS, MOV, Video for Windows). MCI compatible.

ALLEGIANT TECHNOLOGIES
5070 Santa Fe St.
San Diego, CA 92109
800.255.8258
619.587.0500
619.490.9232 FAX

SuperCard 1.7 (Mac) $299. HyperCard-like paradigm designed for non-programmers. Includes direct SuperTalk script control over bitmapped and draw 8-bit graphics (24-bit color display via XCMD), runtime editor, interactive debugger, three levels of compression. Imports text, graphics (PICT), animation (PICS, proprietary STEP sequencing), audio (AIFF, Type 2 sound resources), video (QuickTime). No runtime license fees.

ALLEN COMMUNICATIONS
5225 Wiley Post Way
Suite 140
Salt Lake City, UT 84116
801.537.7800
801.537.7805 FAX

Quest 5.0 (Windows) $3,995. Integrated development system. Includes embedded Quest C language, Quest C Coach (menu-driven C programming for non-programmers), pre-built screen layouts, menus, templates, borders, etc., interactive debugger, extension manager for third-party utilities. Supports 24-bit color. Imports text, graphics (BMT, DIB, GIF, JPEG, PCX, TGA, TIFF, WMF), animation (FLI, CEL, FLC), audio (WAV,

MIDI,CD audio), video (AVI, PMG). No runtime fees.

ALPHA SOFTWARE

168 Middlesex Tpke.
Burlington, MA 01803
617.229.2924
617.272.4876 FAX

Bravo 2.02 (Windows) $79. Presentation tool. Includes embedded text and drawing tools, outliner and sorter, dynamic links, clip art. Supports OLE, 24-bit color. Imports graphics (BMP, TGA, TIFF, EPS, WMF, GIF, PCX, PCD), animation (FLI, FLC), audio (MIDI, VOC, CD audio), video (AVI).

AMERICAN TRAINING INTERNATIONAL

12638 Beatrice St.
Los Angeles, CA 90066
800.955.5284
310.823.1129
310.827.1636 FAX

TourGuide (Windows) $2,950. CBT, kiosk, and presentation development system for non-programmers. Features embedded drawing, 2D animation, and text tools, scene and map templates, graphical and script language editing, automatic response evaluation/scoring. Supports 8-bit color. Imports graphics (BMP, DIB, GIF, PCX, TIFF, DCX, PICT, WPG, TGA, JPEG). Add-on module required for support of audio and full-motion video. No runtime fees.

APPLE

1 Infinite Loop
Cupertino, CA 95014
800.462.4396
408.996.1010
408.974.9974 FAX

Apple Media Tool (Mac) $1,500; (Programming Environment $3,000). Cross-platform object-oriented development tool for creating Mac and/or Windows products. Includes runtime player. Supports up to 32-bit color. Imports text, graphics (PICT), video (QuickTime), audio (AIFF, WAV, SND). Programming Environment is object-oriented language and framework for adding functionality.

HyperCard 2.2 (Mac) $249. CBT, presentations, database, and multimedia development tool. Uses HyperTalk, AppleScript, and OSA-compatible scripting languages. Includes runtime debugger, runtime player. Supports 8-bit color. Imports graphics (PICT), links with over 75 OSA-compatible apps, audio (AIFF, SND), animation, video (QuickTime). No runtime fees.

ASK ME MULTIMEDIA CENTER

7100 Northland Circle, Ste. 401
Minneapolis, MN 55428-1500
612.531.0603
612.531.0645 FAX

Ask Me 2000 (DOS) $495. Media integration tool with graphical user interface. Includes English-language scripting. Imports text (GEM), graphics (PCX), animation (FLI), audio (MIDI, VOC, VAD). $195 runtime license fee.

Ask Me Professional (DOS) $1,795. Adds image creation capabilities, database management functions. Imports text (GEM), graphics (PCX), audio (MIDI, VOC, VAD), full-motion video (via laser disc). No runtime fees.

Super Show & Tell 2.0 (Windows) $150. Slide-show-oriented presentation development tool for non-programmers. Includes runtime player, on-board compression. Supports 24-bit color. Imports text, graphics (BMP, DIB, GIF, TIFF, PCX, TGA, WMF, PCD, JPEG), animation (FLI, FLC), audio (WAV, MIDI), video (AVI). No runtime license fees.

ASYMETRIX

110 110th Ave., NE, Ste. 700
Bellevue, WA 98004
800.448.6543
206.462.0501
206.455.3071 FAX

Compel (Windows) $295. Presentations tool. Includes runtime player, clip media: audio, animation, and video. Imports text, graphics (DXF, CGM, GIF, CDR, EPS, CHT, PIC, PCT, PCX, TIFF, BMP, DIB, WMF), animation (FLI, FLC), audio (WAV, MIDI, CD audio), video (AVI). No runtime fees.

Multimedia ToolBook 3.0 (Windows) $895. CBT, kiosk, application frontend design, title development tool. Includes embedded video editor, animation editor, audio waveform editor and mixer, synchronizer, graphics editor, automatic color dithering, spell checker, search engine, database, DLLs, OpenScript programming language, runtime debugger, runtime player, Video for Windows (w/redistribution rights). Supports OLE, 24-bit color. Imports text (RTF), graphics (BMP, DIB, EPS, WMF, GIF, PICT, PCX, TIFF, CGM, DRW, DNF, JPEG, KDX), animation (FLI, FLC, MMM), audio (WAV, MIDI, CD audio), video (AVI, QuickTime, Video for Windows, laser disc), database (ASCII, dBase, Paradox). MCI compatible. No runtime fees.

ToolBook 3.0 (Windows) $195. Stripped down version of MM ToolBook (see above). Includes embedded search engine, database, DLLs, OpenScript programming language, runtime debugger, runtime player. Supports OLE, 24-bit color. Imports text (RTF), graphics (BMP, DIB, EPS, WMF, GIF, PICT, PCX, TIFF, CGM, DRW, DNF, JPEG, KDX), audio (WAV), database (ASCII, dBase, Paradox). MCI compatible. No runtime fees.

AT&T MULTIMEDIA SOFTWARE GROUP

2701 Maitland Center Pkwy.
Maitland, FL 32751
800.448.6727
407.662.7309
407.662.7117 FAX

Panorama (DOS) $795. CBT, kiosk, video production authoring tool. Includes menu-driven interface, ASCII scripting language, runtime player, animation and video special effects, external call to DOS apps via

CallDOS, automatic scheduling utility. Imports text, graphics (TGA, PIX, VST, WIN), audio (WAV, VOC), video (NTSC/PAL via hardware). No runtime fees.

BLUE SKY SOFTWARE

7486 La Jolla Blvd., Ste. 3
La Jolla, CA 92037-9583
800.677.4946
619.459.6365
619.459.6366 FAX

Multimedia WinHelp (Windows) $199. Designed to add multimedia elements to any Windows Help system. Runtime DLL. Supports 8-bit color. Imports graphics (BMP), audio (WAV), video (AVI). No runtime fees.

BOURBAKI

Box 2867, 475 Main St.
Boise, ID 83702-2867
800.289.1347
208.342.5849
208.342.5823 FAX

ForShow (DOS) $79.

COGNETICS

51 Everette Dr.
Ste. 103B, Box 386
Princeton Junction., NJ 08550
609.799.5005
609.799.8555 FAX

Hyperties Pro 3.0 (DOS) $579/single user; $1,358/20-user site license. Presentation, kiosk, CBT development system. Includes scripting language, database functions. Imports text (ASCII), graphics (PCX), audio (WAV, MIDI, CD-ROM), video (via laser disc). No runtime fees.

Hyperties Lite (DOS) $199. Identical to Hyperties Pro except its database capacity is limited to 100 "articles."

CONCEPTS IN COMPUTING

401 Park Ave.
Beloit, WI 53511
800.236.1553
608.365.2992
608.365.7114 FAX

Advisor (DOS) $1,500.

Summit for Windows (Windows) $4,395.

CREATIVE LEARNING SYSTEMS

7901 4th St. N., Ste. 101
St. Petersburg, FL 33702-4300
800.229.3937
813.576.1108
813.576.1086 FAX

Leverage $299 (DOS). Integrated programming environment for professional developers. Includes embedded draw, text (w/150 fonts), animation, and special effects tools, English-style scripting language, debugger, runtime player, open architecture for third-party tools. Imports text, graphics (PCX), audio (WAV, VOC, CD audio), video (analog and laser disc). No runtime fees.

DATALUS

4767 Okemos Rd.
Okemos, MI 48864
517.347.1333
517.347.2466 FAX

MultiMedia DeskTop (Windows) $395.

DIGITAL IMAGING ASSOCIATES

10153 York Rd., Ste. 107
Hunt Valley, MD 21030
800.989.5353
410.628.9200
410.628.0915 FAX

Peak (Mac) $149/single user; $1,495/building-level site license w/training. Presentation and lesson-oriented media integration tool for teachers. Supports 8-bit color. Imports text, graphics (PICT via HyperCard 2.2), animation (Director files), audio (SND), video (QuickTime). No runtime fees.

GOLD DISK

3350 Scott Blvd., Bldg. 14
Santa Clara, CA 95054
800.465.3375
408.982.0200
408.982.0298 FAX

Animation Works Interactive (Mac) $495. Presentation, kiosk, and CBT tool. Includes embedded text, paint, animation, special effects generation and editing. Runtime player, accelerator for speeding up movie playback, compression. Supports OLE, 8-bit color. Imports text, graphics (DIB, BMP, TIFF, GIF, PCX), animation (FLI, CEL, RLE, TGA, CGM), audio (WAV, MIDI, CD audio), video (DVI). MCI compatible. No runtime fees.

HSC SOFTWARE

1661 Lincoln Blvd., Ste. 101
Santa Monica, CA 90404
310.392.8441
310.392.6015 FAX

HSC InterActive 2.0 (Windows) $295. Icon-oriented authoring system. Includes video editor, waveform editor, animation editor, graphics editor, 3D charting package, templates, runtime players, and video, sound effects, music, graphics clips. Supports 24-bit color. Imports text (ASCII), graphics (PCX, BMP, RLE, GIF, TGA, PICT, JPEG, DCX, TIFF, EPS, DIB, WMF, WPG, ICO), audio (WAV, MIDI), animation (FLI, FLC, MMN, MOV), video (AVI, AVS, MOV). MCI compatible. No runtime fees.

IBM

Old Orchard Rd.
Armonk, NY 10504
800.426.2255
914.765.1900

Audio Visual Connection (OS/2, DOS) $571.

LinkWay Live! (DOS) $269-$2,263.

Ultimedia Builder/2 (OS/2) $345.

IMAGE NORTH TECHNOLOGIES

180 King St. S, Ste. 360
Waterloo, ON, Canada N2J 1P8
800.363.3400
519.570.9111
519.570.9140 FAX

ImageQ 2.2 (Windows) $749. Presentation, kiosk, multimedia authoring system. Includes object-oriented scripting language, 250 pre-scripted objects, DLLs, EXE file compiler (no runtime player necessary), draw and text tools, image dither, debugger. Supports up to 24-bit color. Imports text (ASCII), graphics (BMP, TGA, VII, PCX, GIF, TIFF, WIN, RLE, KDX, HKF), audio (WAV, MIDI, CD audio), animation (AVI), video (AVI, MPEG, DVE, Video for Windows, laser disc), MCI compatible.

INFOACCESS

2800 156th Ave. SE
Bellevue, WA 98007
206.747.3203
206.641.9367 FAX

Guide Author (Windows) $795. Icon-oriented electronic document design and publishing tool. Includes embedded word processor, search engine, runtime player, external calls to Windows apps. Imports text (ASCII, RTF), graphics (BMP, DIB, PCC, MSP, TIFF, PCX, CGM, WMF), and audio, animation, video (via MCI). No runtime fees.

INFORMATICS GROUP

100 Shield St.
West Hartford, CT 06110
800.348.1377
203.953.4040
203.953.7407 FAX

Act III (DOS) $495.

INTERACTIVE MEDIA CORP.

Box 0089
Los Altos, CA 94023-0089
415.948.0745

Special Delivery 2.0 (Mac) $399. Slide presentation metaphor tool for non-programmers. Imports text, graphics (PICT, KDX), audio (AIFF, SND), video (QuickTIme). Runtime player optional.

INTERSYSTEM CONCEPTS

Box 1041
Columbia, MD 21044
410.730.2840
410.730.8228 FAX

Everest (Windows) $4,395.

IPRAX

1 Forbes Rd.
Lexington, MA 02173
617.861.1861
617.861.3828 FAX

Iprax Build (Windows) $3,995. Interactive video authoring system for non-programmers. Includes embedded word processor, video editor, closed-captioning, error-checking, runtime editor, voice-over capability. Imports text (ASCII, RTF), graphics (BMP, PCX, TIFF, KDX, EPS, GIF, IMG, JPEG, MAC, MSP, WPG, PICT, CLP, assorted fax formats), animation (via EXE linking), video (AVI, DVI, Novell Netware, laser disc), audio (WAV). MCI compatible.

KALEIDA

1055 B Joaquin Rd.
Mountain View, CA 94043
415-335-2000
415-335-2096 FAX

ScriptX (Mac, Windows) $1,000. Cross-platform development tool still in beta. Ver. 1.0 available in December. See sidebar, page 91, for overview.

LENEL SYSTEMS INTERNATIONAL

290 Woodcliff Office Park
Fairport, NY 14450-4212
800.225.3635
716.248.9720
716.248.9185 FAX

Media Developer 2.0 (Windows) $695. Media integration tool. Includes, video capture software, direct database ins, thumbnailing, media segmentation, and customizable user interface tools, open architecture for Visual C++ and Visual Basic languages, runtime player. Supports OLE, DLLs, up to 32-bit color. Imports text animation (FLI, FLC, AWM, AWA, MMM) audio (WAV, MIDI, RMI), video (AVS, AVI, MOV, JPEG, PIC, laser disc), graphics (ART, BMP, CUR, GIF, ICO, JPEG, CMP, PIC, MTX, RLE, PCX, PCD, TIFF, TGA, DIB). MCI compatible. No runtime fees.

LOOKING GLASS SOFTWARE

11222 La Cienega Blvd., Ste. 305
Inglewood, CA 90304-1104
800.859.8500
310.348.8240
310.348.9786 FAX

MediaVerse (Windows) $799. Electronic publishing, CBT, kiosk, presentation, etc. authoring system. Includes embedded media editors: text,

graphics, audio, 3D modelling and animation, video, database, interface design, Mac and Windows runtime players, two levels of compression. Supports OLE, 24-bit color. Imports text (ASCII, RTF), audio (WAV), video (AVI). No runtime fees.

MACROMEDIA

600 Townsend St., Suite 310w
San Francisco, CA 94103
800.288.4797
415.252.2000
415.626.0554 FAX

Authorware Professional (Mac/Windows) $4,995. CBT, kiosk, presentation, title development tool. Includes embedded animation tools, search engine, DLLs, scripting language. Supports 24-bit color. Imports text (ASCII), graphics (BMP, DIB, WMF, GIF, PCX, TIFF, CGM), animation (FLI, FLC, MMM), audio (WAV, MIDI), video (QuickTime, Video for Windows, laser disc). MCI compatible.

Director (Mac) $1,195; Runtime only players (Mac or Windows) $995. CBT, kiosk, presentation, title development tool. Includes embedded 2D animation tools, transition effects, text editor, programming language, synchronization, audio editor. Supports up to 24-bit color. Imports text (ASCII), graphics (BMP, DIB, EPS, WMF, GIF, PICT, PCX, TIFF, CGM, DRW, DNF, JPEG, KDX), audio (WAV, MIDI, CD audio), animation (FLI, FLC, MMM), video (QuickTime, Video for Windows, AVI, laser disc), database (ASCII, proprietary). MCI compatible. No runtime fees.

MICROSOFT

1 Microsoft Way
Redmond, WA 98052-6399
800.426.9400
206.635.6100 FAX

Multimedia Viewer Publishing Toolkit (Windows) $495. Online publishing tool. Includes search engine, runtime player, BitEdit, PalEdit, waveform editor, DLLs. Imports text (requires Microsoft Word for conversion or SGML), graphics (FLI, FLC), audio (WAV, MIDI, CD audio), video (Video for Windows). MCI compatible. No runtime fees.

MOTION WORKS

Ste. 130, 1020 Mainland St.
Vancouver, B.C.
Canada V6B 2T4
604.685.9975
604.685.6105 FAX

Multimedia Utilities (Mac) $295. Multimedia extension utilities for use with HyperCard, Power Point, Director, Persuasion, Impact, SuperCard, Premiere. Modules add QuickTime hotspots, screen activity (including sound) recorder, cel animation, QuickTime editing, sound editing, and morphing capabilties. Supports 24-bit color, 16-bit audio. Imports graphics (PICT), audio (AIFF, SND, WAV, SAN), animation (PICS, PROmotion), video (QuickTime).

PROmotion (Mac/Windows) $395. Animation processor and presentation tool. Includes animation editor, paint and effects editor, sound editor, cel sequencer, scripting language, clip media. Supports 24-bit color. Imports video (Quicktime).

NTERGAID

60 Commerce Park
Milford, CT 06460
800.254.9737; 203.783.1280
203.380.1465 FAX

HyperWriter! (DOS/Windows) $495/v.3.1; $695/v.4.0.

OPTIMAGE

1501 50th St., Ste. 100
West Des Moines, IA 50266
515-225-7000
515-225-0252 FAX

Media Mogul (Mac) $5,000.

PARADISE SOFTWARE

7 Centre Dr., Ste. 9
Jamesburg, NJ 08831
609.655.0016
609.655.0045 FAX

Mediawrite (Sun/Open Windows) $995/call for site license info. Multimedia application development system. Integrates text, graphics, audio, video. Generates executable C program. Supports hyperCmedia Toolkit 3.1, video (Uniflix ToolKit), graphics (Parallax XVideo), video players (Sony IP, VISCA; Pioneer, NEC, Panasonic). Call for runtime player and license fee information.

PASSPORT DESIGNS

100 Stone Pine Rd.
Half Moon Bay, CA 94019
415.726.0280
415.726.2254 FAX

Producer Pro (Mac, Windows version in beta) $995. Title development, CBT, kiosk, video production tool. Includes Cue sheet-style interface, SMPTE synchronization, background generator, open architecture, runtime player, object animation, realtime video capture to QuickTime, media editors for: MIDI, QuickTime, PICT graphics. Supports 24-bit color. Imports text, graphics (PICT, TIFF), animation (PICS), audio (AIFF, MIDI, CD audio), video (QuickTime). Machine control (NISCA, Pioneer laser disc, VLAN, ARTI). Cross-platform development (via runtime player for Mac and Windows). No runtime fees.

PAUL MACE SOFTWARE

400 Williamson Way
Ashland, OR 97520
800.944.0191
503.488.2322
503.488.1549 FAX

Grasp 4.5 (DOS, Windows, OS/2) $895. Presentation development

tool. Includes embedded paint program, transistion and animation effects, text-to-bitmap converter, programming language (w/support for wide variety of third party languages including Borland C/C++, Turbo Pascal 7.0, MS QuickBASIC 4.5, etc.), runtime player. Supports 24-bit color, simultaneous audio/video playback. Imports text, graphics (PIC, PCX), animation (FLI, FLC), video (video capture, AVI through third party add ons). Runtime fee is mention of Grasp 4.5 in final app.

MultiMedia Grasp (DOS, Windows, OS/2) $895. Media integration command language. Includes embedded paint program, transistion and animation effects, compression, font editor, image editors, screen capture utilities, text-to-bitmap converter, programming language (w/support for wide variety of third party languages including Borland C/C++, Turbe Pascal 7.0, MS QuickBasic), debugger, runtime player, programmer's library w/high-speed FastCall interface. Supports up to 32-bit color, simultaneous audio/video playback. Imports text (ASCII, ANSI via $49 font grabber utility), graphics (PIC, PCX, TGA, GIF, EPS, TIF, BMP), animation (FLI, FLC), audio (VOC, DMA), video (video capture, AVI through third party add ons). Runtime fee is mention of MultiMedia Grasp in final app.

Visual Grasp (DOS) $99. CBT, presentations, electronic book, etc. graphical development tool for non-programmers. Includes index and search functions, scripting language, draw tools, runtime player. Imports text, graphics (PCX, GIF), animation (FLI, FLC), audio (runtime player-dependent VOC, SND).

PROTOBYTE

6050 Peachtree Pkwy., Ste. 340-204
Norcross, GA 30092
404.623.1111
404.623.9660 FAX

OverText Multimedia Authoring System (DOS) $599.

Q/MEDIA SOFTWARE

312 East 5th Ave.
Vancouver, BC
Canada V5T 1H4
800.444.9356
604.879.1190
604.879.0214 FAX

Q/Media 2.0 (Windows) $199. Entry level presentations, kiosk, CBT tool. Includes outline planner, drawing and text tools, special effects and transistions editor, runtime player, clip media: graphic, music, sound effects, video, animation. Supports OLE, 8-bit color. Imports graphics (BMP, WMF, TIF, GIF, PCX, DIB, TGA, JPEG, WPG, PCT, EPS, DCX, PCD), animation (FLI, FLC, AWM, AWI), audio (WAV, MIDI, CD audio, RMI), video (AVI, AVS, MOV, MPEG, laser disc). MCI compatible. No runtime fees.

STRATA

2 W. St. George Blvd., Ste. 2100
St. George, UT 84771-1750
800.678.7282
801.634.7648
801.634.7640 FAX

MediaForge (DOS) $795. Presentations, CBT, video, title development tool. Includes embedded paint and animation editor, text editor, music editor, slide show editor, scripting editor, screen recorder, special effects library, open architecture, dynamic extensions via C or Pascal, student progress/testing tracking database, runtime player. Supports 8-bit color. Imports text, graphics (PCX), animation (PCX, PCC, FLI, FLC), audio (WAV, MIDI, VOC, CD audio), video (AVI, laser disc). No runtime fees.

SYBASE

6475 Christie Ave.
Emeryville, CA 94608
800.232.4246
510.596.3500
510.658.9441 FAX

Gain Momentum (UNIX/Motif, Windows NT) $10,000. Multimedia applications development tools suite. Includes media editors: desktop publishing, paint/photo program, audio capture, special effects, animation, video, CBT tools, and user interface controls; compression, synchronization, scripting language, open architecture, DLL, OLE [on Windows platforms], debugger, compiler. Imports graphics (TIFF, EPS, Sun raster), audio (DAT, CD audio, DMA [on Windows platforms only]), animation (bitmaps from video capture tools).

SYNCRO DEVELOPMENT

580 Middletown Blvd., Ste. D-203
Langhorne, PA 19047
215.741.0300
215.741.3230 FAX

Multimedia Impact (Windows) $4,995.

TOTAL MULTIMEDIA

299 W. Hillcrest Dr., Ste. 200
Thousand Oaks, CA 91360
800.362.6829
805.371.0500
805.371.0505 FAX

TMM Producer (DOS) $2,995-$4,985.

VIVIDUS

378 Cambridge Ave., Ste. I
Palo Alto, CA 94306
415.321.2221
415.321.2282 FAX

Cinemation (Mac) $495. Presentation, CBT, and animation tool. Includes embedded paint and animation programs, HyperCard playback and control, presentation templates, clip media: animation, transistions, music, sound effects. Supports 24-bit color. Imports text, graphics (PICT, PICS, MacPaint, Scrapbook), audio (SND), video (QuickTime). No runtime fees.

Desktop Video

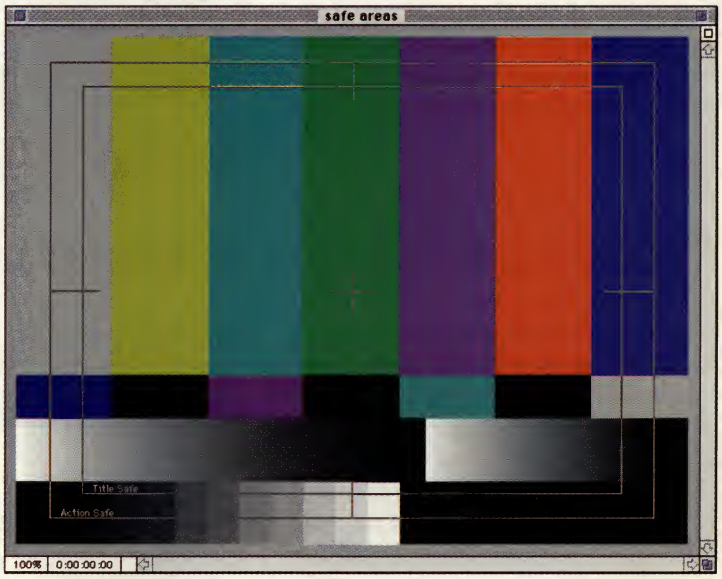
Memoires from the Bleeding Edge

BY CHRIS MEYER

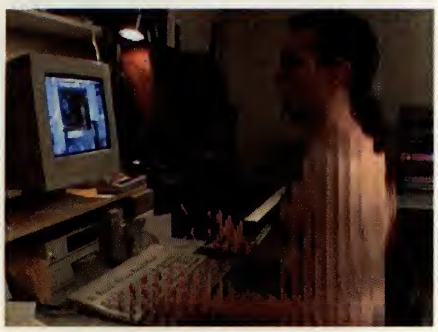
Welcome to Frames of Reference, a series of memoirs from the bleeding edge of Desktop Video. The goal is to share personal experiences with some of the "gotchas" waiting to trip you up in the middle of a project, along with ways to get around or even avoid them yourself. During lulls in the battle, we'll also discuss basic technology issues, and try to pick out trends as they loom on the horizon.

The first challenge is defining "desktop video." There was a time when it meant any video work not done at a major studio or post-production house. For example, a small studio with three VTRs and a hardware-based edit controller used for in-house industrial videos or editing weddings for hire. Today some feel it means any video created and played solely on a personal computer, such as video snippets for CD-ROM applications or multimedia presentations. Others take it to mean any video or film process that touches a non-dedicated computer at some point — even if that computer is an SGI workstation hitched to a film recorder.

Don't expect anything more well-defined out of me; I've been involved in all the above at some point. For me "desktop video" means any project where the images are going to be edited, manipulated, composited, and effected inside a personal computer. Actually, the fact we're using flexible personal computers means we can take on a wide variety of jobs — from 240x180-pixel 12-frame-per-second QuickTime movies to VHS-quality video played in real time from our hard disks to non-realtime non-compressed frames destined for highend video or film. And knowing the difference is important — you can't always apply what you learned in one format to another.



A television's image area is smaller than a computer's, so it's necessary to keep live matter within safe areas. Keep text within the inner boundary, while important images should stay within the outer rectangle.



Chris Meyer researches Multimedia Production for Roland Corporation. A self-identified QuickTime Baby who bought a VideoSpigot, Hi-8 camera, and Premiere 1.0 as soon as it shipped, he has since graduated to resident tech for his wife's desktop motion graphics company, CyberMedia in Calabasas, California.

Let's talk a bit about those different environments and how they interact with the way you'll have to work. If you're already familiar with the basics, bear with me as I work through them. I promise you at least one gotcha before we're through.

On one end of the spectrum are QuickTime and Video for Windows movies that play back inset on a computer's screen, often using some form of software-only compression. Typical early sizes were 160x120 to 320x240 pixels, played back at rates from 10 to 15 frames per second. In these cases, the frame size is so small relative to that of the whole screen that you usually have to design your image or text to fill the entire frame to be legible. The low frame rate also precludes fast motion lest an object be here one frame, gone the next.

Today, 320x240-pixel frame sizes are common, often zoomed to fill an entire 640x480 screen. Frame rates are also increasing to 15 or a video-like 30 fps. MPEG 1 video, which is fast becoming an important standard for delivering entertainment on personal computers, is itself a 320x240-pixel image zoomed and played at 30 fps. With these formats, you can now seriously consider having more than one object on screen at a time, and the user can be expected to follow them without repeated viewings (or extreme annoyance).

Moving towards the other end of the spectrum are hardware compression cards that can play back 640x480-pixel images at 30 frames per second. From a multimedia perspective, these are great for kiosks or video-like presentations that can be displayed interactively. Some brave pioneers are even doing "real video" with these cards for industrial, cable, and occasionally broadcast work. However, there are important

differences between "video-like" computer formats and "real video" — differences, as I hinted above, that can cause big trouble if you design for one and play back on another.

The most commonly discussed difference is frames versus fields. A computer monitor draws its pixels horizontally across the screen, working its way from top to bottom one line at a time. When done, it starts over at the top. This is called progressive scanning. The refresh rate you see mentioned in conjunction with different monitors or screen sizes — i.e. 67 Hz for a Macintosh 640x480 display — is how often it does this. However, NTSC video works differently: It draws every other horizontal line on its way down, then goes back to the top and fills in the other lines. Each half-image is called a field, and fields are drawn at 60 fps (actually, 59.94 fps, and that difference can be another gotcha — but we'll discuss that in a future column). The way they are merged is called interlacing. You could say NTSC video is 640x240 pixels at 60 fields per second, with two of these fields needing to be combined to create a 640x480-pixel frame.

Now for the problems. Animations created at 30 fps won't take full advantage of the actual 60 field-per-second nature of video, and therefore won't move as smoothly as they could. The solution is the *field render* option, which will compute motion and other changes at 60 fps and properly interlace pairs of fields into frames. An increasing number of DTV and animation programs are starting to support field rendering. If the animation program you use doesn't, then pre-render your animations at 60 fps and reprocess the result through a program that does field-render. (Yes, this will take more time and disk space, but if you want that last bit of quality . . . .) You will be asked which field you want drawn first — field 1 or 2 (sometimes called even or odd, upper or lower, etc.). Sorry, there is no standard; most systems I've encountered are upper field first, but you'll want to run a test file with fast motion and play it back on your target system to be sure.

Many video cameras, VTRs, and video capture cards don't fill the entire frame with meaningful image. It is not uncommon to have a few black or distorted pixels along the bottom or side.

The other problem in going from computers to NTSC is that if very thin horizontal lines appear on only one field and not the other, the result will be nasty flickering. Some output devices have convolution or de-flicker circuitry that blur the image enough to spread them across more than one line so they won't vibrate as much. You can fix this yourself by avoiding one-pixel horizontal lines — either make them two pixels thick, or add a blur or drop-shadow to spread them over more than one pixel. Another trick is to shift an image down half a pixel, which in higher-quality programs will result in those lines being spread over two pixels as a result of anti-aliasing.

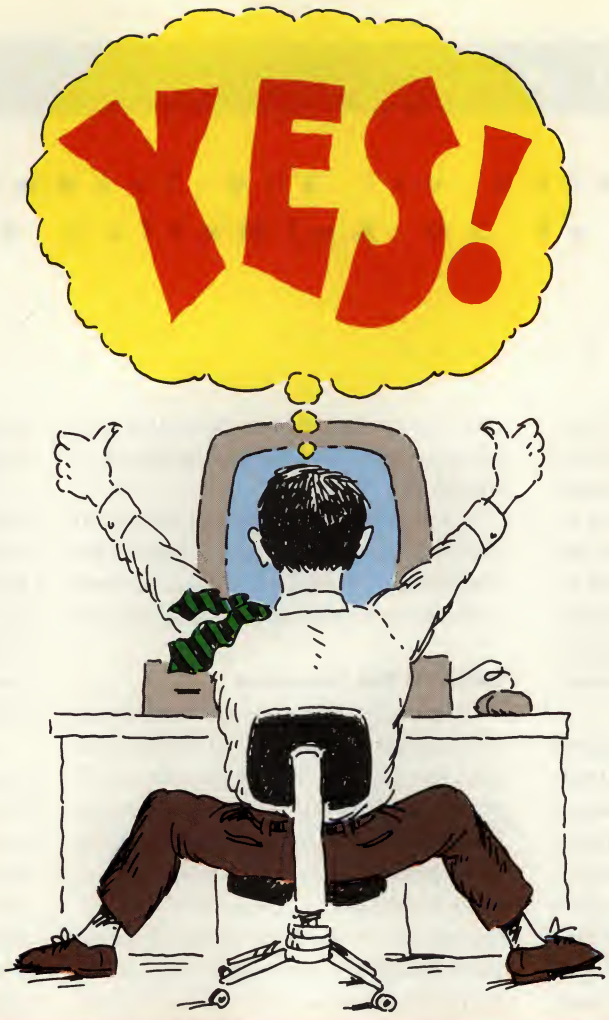
The other problem in going from computers to NTSC is that if very thin horizontal lines appear on only one field and not the other, the result will be nasty flickering.

There are problems going the other way as well. If you are starting with real video and playing back later on a computer monitor, you don't want to create interlaced fields, you want to remove them! Video captured full-frame with a lot of motion will exhibit skewed pixels where the fields interlace, and this won't look right on a progressive scan monitor. In this case, you will need to run a de-interlace filter on the captured video. These throw away every other line (one field) and replace it either with a replica of a line next to it or an interpolated mixture of the lines above and below it. It seems a crime to throw away half your pixels, but if there are objects moving in the frame, you'll have to.

Another problem is the difference between what a frame contains and what you can see. On a computer monitor, you see the entire image. On an NTSC monitor (i.e. your TV) a significant portion is cropped off around the edges. This is called overscanning, and was designed to hide some of the imperfections in early TVs such as poor image centering and distortion at the edges. When designing for NTSC video playback, you have to keep any elements you want seen inside the action safe area, which is inset 5% from the edges of the image. To avoid any lingering edge distortions, text should also be kept inside the title safe area, which is another 5% inside action safe (see the illustration). This reduces the effective frame area you have to play in — and if you ignore it, parts of your image will get chopped off. Don't forget to expand your backgrounds over the entire frame anyway, in case they peek through on a particular TV (this is similar to the print concept of bleeding off the page to protect against print registration or page cutting problems.)

Again, this problem cuts both ways: Many video cameras, VTRs, and video capture cards don't fill the entire frame with meaningful image. It is not uncommon to have a few black or distorted pixels along the bottom or side. They are well outside the action safe overscan area on an NTSC monitor, but play it back on a computer screen that shows the entire image — even with just a 160x120-pixel inset — and these edges will stick out. Be prepared to have to crop your video captures to look clean when played back edge-to-edge on your computer.

Speaking of safe areas, I see this particular column is about to overscan the space allotted, so I'll leave you with one more warning/teaser. The common 640x480 pixels of a computer screen is not always the size of "real" video. Many highend video cards actually deal in 648x486 pixels, or even 720x486 pixels where each pixel is actually a rectangle — not a square. We'll talk about that, along with other related input/output issues, the next time you click on this space.



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Artistic Vision vs. the Tyranny of 3D Animation Technology

BY CYRUS LUM

No doubt about it, 3D animation is hot. It's in demand for movies, TV, and multimedia. The tools for creating it are becoming easy to use and easy to buy. Audiences as well as artists are aware of the power of 3D animation in bringing imaginary characters to life. But just having the hardware and software doesn't mean that anybody can make fantastic animations.

The most important element of really great animations is personal creativity. What tends to happen when people start using 3D animation programs is that they rely on the software's custom features instead of their own imagination to create images. As a result, we've been treated to an infestation of chrome geometric objects floating over checkerboard floors in front of digitized skies. There's also no dearth of custom special effects such as lens flare and rippling water. This kind of work, so lacking in personal creativity and style, deserves to be called computer generated animation — it looks sterile and is noticeably computery (to coin an adjective).

It's important to remember that, even though we're working on the computer, the computer isn't creating the animation. Hardware and software are not creative vision. You are.

Turn Off the Computer

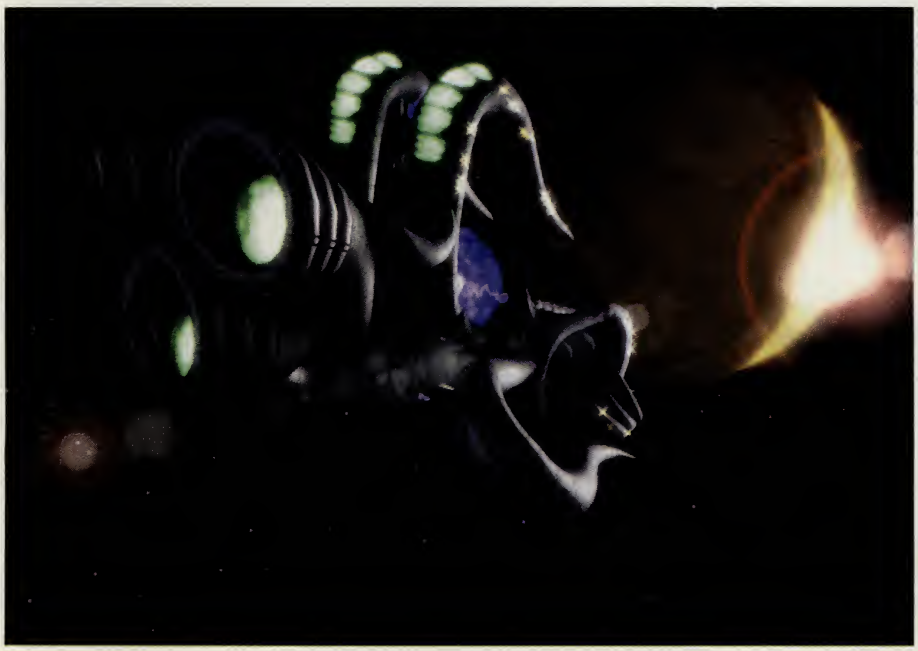
To get started I develop a composition and an animation concept without thinking about what the software or hardware can do. I'll come up with a basic premise — what's the subject of the piece, what's the subject doing in the piece, what is it that you want to say about the subject . . . . Once I have the basic concept I turn to good old analog technology: paper and pencil. Sketching on paper is still the fastest and freest way to play with ideas. In this way, I'm not concentrating on where to put each vertex. I'm focusing on the overall look and composition. For me, this becomes very important when I design characters for animation projects.

With paper and pencil, I'll draw out different ideas for the character. I'll also draw the character in different poses that are strong in body language. These poses reveal the expressive acting possibilities of the character. Sometimes, they even inspire new ideas for the animation. Later, I use these sketches as references for the modeling and animation work.

During this development process, I'll think about the things that would support the type of reaction that I want the viewer to have when seeing the animation — happy, peaceful, aggressive, horror, surprise, or just symbolic and weird. I'll work on such elements as the environment and the audience's point of view (third person, first person), and relationship to the subject (larger, smaller) — all in support of the main concept.

There are many ways to show or enhance the emotional atmosphere of the animation. For example, to invoke a sense of horror in the viewer, I might use high contrast lighting — definite highlights and dark shadows. I might also include twisted, ambiguous shapes in the background and may even position the camera lower than the subject to make the viewer feel powerless.

Notice the lens flare effects, the florescent green glow implying power, the use of shadow and highlight on the horns of the ship, and the blinging glare of a star peaking out from behind the planet — all add to the viewer's sense of otherworldliness.



Lights, Camera, Action, and Fooling Around

After sketching out my characters and coming up with basic scenarios, I'll start to storyboard the concept to solidify the various elements and their composition to help me see anything major that won't work in the animation. I'll also have a basic lighting scheme in mind at this point.

Lighting is very important for both mood

Cyrus Lum is the lead story artist for Crystal Dynamics. He's contributed animation for *The Horde*, *Total Eclipse*, and *Crash and Burn*.

and to focus the viewer's attention. Lights can also be used to heighten emotional responses and to communicate atmosphere. Specifically, I tend to use spotlights to reinforce dramatic situations or actions. With spotlights I can cast shadows and create highlights to give the animation strong contrasts. I find I can use shadows and highlights to emphasize body language. Keep in mind, also, that shadows are just as important as lights.

Once I've got a strong direction and a sense of what I'm doing, I'll begin to implement the animation. Even at this point there's still a lot of experimentation to do. Most if not every animation is unique with different challenges when it comes to implementation. I really look forward to this stage, because it's here that I learn and develop techniques. I've learned a great deal from each project I've done. Through this learning process I've developed my own style. Leave time in your animation project to experiment.

Don't neglect your characters. When creating character animation, take the time to get the characters to act. Use the character's body language and facial expressions to communicate to the viewer. Play with timing — make use of dramatic pauses to make a point. By experimenting, you learn how to use the software and hardware tools your way. This has allowed me to explore different ways of using the features of a program.

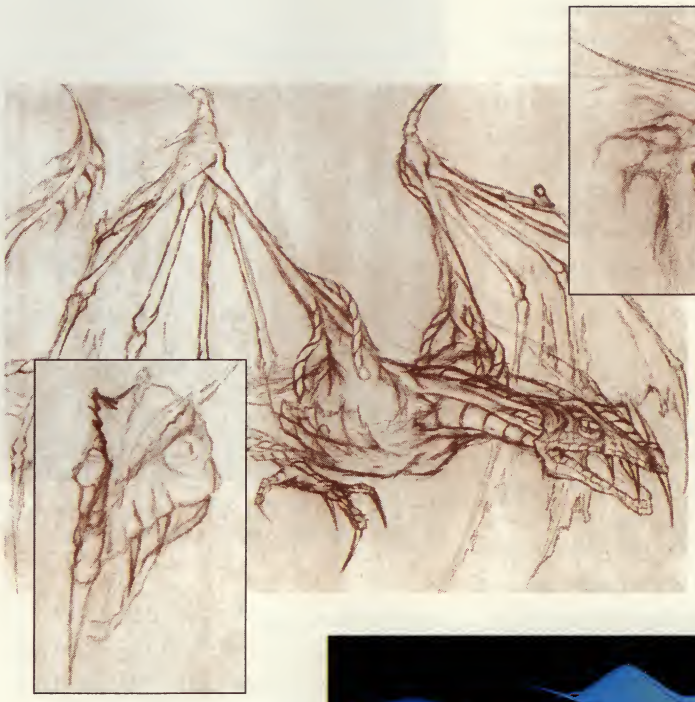
A case in point: The plan was for a wall to burn through and reveal a word. At the time, I was using Alias Power Animator running on an Indigo 2. Alias Power Animator doesn't have a Burning Through Things Like Walls feature, so I went off and started to play with some of the available special effects. Through trial and error, I ended up using the most unlikely function to create my burning effect — a shader for creating marble textures.

By using an animated version of this shader (I simply animated the vein width) and some glow effects, I was able to achieve the right effect. You can see the effect in the Crystal Dynamics company logo.

I enjoy creating effects using methods that are unique to me, because they introduce stylistic elements that might not be so easily duplicated by next year's super computer application. It's also a way of insuring my own marketability in the future.

The flip side of all this is easily illustrated. Take, for example, a couple of logo generation programs — Pixar's Typestry and Crystal Graphic's Crystal Fonts. There were all kinds of logos being designed that looked like nothing more than the demos that came with those programs. Again, the element of personal creativity is the distinguishing factor. *It is not a feature provided in software packages!*

In this spirit, try not to draw attention to lavish program effects like fire and sparkling water just for the sake of using it. These cool effects might get people to look at your work at first,



Once the basic premise is established, turn to good old analog technology — pencil and paper, still the quickest way to play with ideas.

Above, character studies done in brown pencil for the dragon. Right, the initial model, before adding wings or skin texture. Below, the finished creature.

but sooner or later every other animator will jump on the bandwagon. Before you know it, the effect will be becomes trite and clichéd. Just how many times is particle animation or morphing really called for in your story? Better yet, how many places is lens flare likely to show up?

Experiment and implement, but don't lose sight of the concept you worked out at the start. Use only those elements that support or enrich the concept. Avoid flashy techniques or features that might distract the viewer from the concept. What you'll end up with is another technology piece that might look cool, but is going to be quickly forgotten.

Tell the Story

For an animator, there's nothing worse than creating a piece that is quickly forgotten. Animation simply takes too long to produce. I try to get the viewer to really look at the piece. Forming an animation around a concept or a message and presenting it uniquely inspires wonderment in viewers. Try to pique their curiosity. Be creative developing anticipation and building excitement with discovery. By leaving an impression on the viewer, the piece will seem more significant. And that helps justify all the time and work I put into it.

On a more practical note, grabbing the attention of people is especially important for clients. Most contracted animation is for advertising. If you're the animator with a special, memorable touch, you'll be in demand.

Everything about this ship screams power and speed. Its shadow, the discoloration on its wings, the diminishing perspective of the runway . . . all support the impression of a vast object in motion.

And be sure your skill is appreciated and your medium is used to its fullest potential. Don't fall into the trap of believing great 3D animations always have to be totally realistic. I've seen really cool things like forests, cars, buildings, and even an animation of Yosemite that were photographically perfect to the last detail. But honestly, you're better off taking a picture or recording a video of this stuff. Putting tremendous effort into synthesizing it just gets people coming around saying, "Wow that's a cool photograph." Not realizing the effort required to create the thing. Really great 3D animation is animation with a sense of style that communicates a definite message through every element that went into it.

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To put it simply, 3D computer animation, just like all other media, is a communications medium. The animator and the viewer get more out of it when it's used to communicate.

Certain subjects demand more subtle treatment. Here, the light reflects off the sandy ocean bottom and illuminates the underbelly of the shark.

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